# NATURE

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## CONTENTS

PAGE

Polar Exploration . . . . . 535
Protection against Air Raids. By E. H. K. . . . . 537
Teaching Methods. By Dr. R. H. Thouless . . . . . 538
The Thermionic Valve: Principles and Practice . . . . . 539
A Study of Drugs. By Dr. W. O. Howarth . . . . . 540
Combination Tones in Sound and Light. By Sir William Bragg, O.M., K.B.E., Pres.R.S. 542
Some Scientific Researches in the Region of Mount Everest. By N. E. Odell . . 545
Obituary Notices:
Prof. E. B. Wilson, For.Mem.R.S. By Prof. E. W. MacBride, F.R.S. . . 547
Prof. A. P. Coleman, F.R.S. By Prof. T. C. Phemister . . . . 547
Dr. Louis Fabry. By M. D. . . . . 548
Prof. N. V. Nassonov. By Dr. B. P. Uvarov . . . . . 549
Prof. H. A. Cummins, C.M.G. By Prof. J. C. Sperrin-Johnson . . . 549
News and Views . . . . . 550
Letters to the Editor:
Activity of the Succinic Dehydrogenase.—Sir F. Gowland Hopkins, O.M., F.R.S., Dr. C. Lutwak-Mann and E. J. Morgan . . . . . 556
Lactic Dehydrogenase and Cytochrome.—Dr. Malcolm Dixon and Dr. L. G. Zerfas 557
A New Method of the Determination of Saturation by Vitamin C.—Dr. Andreas Góth 557
Free and Bound Vitamin $B_1$ in Milk.—J. Houston and Dr. S. K. Kon . . 558
Production of Diacetyl by Fæcal Streptococci.—J. G. Davis, H. J. Rogers and C. C. Thiel 558
Quantitative Inhibition of Œstrone by Progesterone in the Baboon, with Reference to this Phenomenon in other Animals.—Joseph Gillman and H. B. Stein . . 559
Transmutations of Uranium and Thorium Nuclei by Neutrons.—Dr. E. Bretscher and L. G. Cook . . . . . 559
Liquefaction of Helium.—Prof. A. van Itterbeek . . . . . 560
Effect of Foreign Gases on the Continuous Absorption Spectrum of Bromine.—Prof. N. S. Bayliss and A. L. G. Rees . . . . . 560
Theory of Mesons and Nuclear Forces.—E. C. G. Stueckelberg . . . . 560
Growth of the Large-mouth Black Bass, *Huro salmoides*, in Lake Naivasha, Kenya.—David H. Thompson . . . . . 561
Course of Pollen Tube Growth in *Carica papaya* and *Cucurbita* spp.—Dr. Hamilton P. Traub and Charles T. O'Rork, jun. . . . . 562
Ferrous Iron in Soils.—Dr. V. Ignatieff . . . . . 562
"Animal Treasure".—Ivan Sanderson . . . . . 563
Foam on the Dead Sea—and off the Mæander River.—Prof. John L. Myres, O.B.E. 564
Research Items . . . . . 565
The South-West Essex Technical College and School of Art. By F. G. W. B. . . 568
Peneplains and Related Land Forms. By Dr. S. W. Wooldridge . . . . 569
Physics in the Textile Industries. By Dr. A. B. D. Cassie . . . . . 570
Forest Administration in Malaya . . . . . 571
University Events . . . . . 572
Science News a Century Ago . . . . . 572
Societies and Academies . . . . . 573

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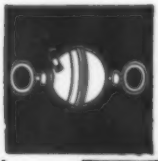

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# Polar Exploration

THE most casual reader of the daily press will have noticed an increased frequency of references to expeditions, mostly to the Arctic, in recent years. Speaking broadly, before the Great War, interest in Great Britain in the Arctic was limited mainly to hunting parties and to one or two scientific expeditions led by senior men. Since the War, however, there have been some thirty or forty summer expeditions and half a dozen wintering expeditions in the north from this country, excluding many smaller ventures of two or three men in a party. More significant still, these have practically all been organized and manned by young men, usually from a university.

We are not concerned here with the reasons for this remarkable change, and indeed no one reason will account for it. It is important to realize, however, that it is not just a fashion or a cult, nor can it be dismissed lightly as an outlet for the energy of youth. Not only do the expeditions take themselves quite seriously, but they nearly always attempt serious work and usually return with useful and important results. Youth has certainly won its spurs in the field of polar exploration.

Now, as before the War, the real spiritual parent and patron of all exploration from Great Britain is the Royal Geographical Society ; but in consequence of this new activity there has arisen a group of subsidiaries, in close and harmonious touch with the Society, who make it their business to foster and even direct such work.

Perhaps the most official and permanent of these is the Scott Polar Research Institute at Cambridge, established in memory of Captain Scott. While its slender funds still limit its assistance to matters of advice on equipment and access to past records, it is rapidly becoming a centre at which experience can and does forgather. Moreover, its half-yearly publication, the *Polar Record*, does an important service in recording and reviewing the work done in the field, by all nationalities and in both the polar regions. The Oxford University Exploration Club is another organization which has for many years produced at least one expedition a year, and has seen to its results being published. It does not confine its activities to the polar regions. The more junior but numerically larger Public Schoolboys Exploration Society is yet another, with aims somewhat similar to those of the senior organizations. Worthy of mention also, though not as directly fostering exploration, are the Antarctic Club, formed in 1924, and the Arctic Club, formed in 1932. These are social clubs only, and their functions serve as happy reunions of a private character.

The real backbone of financial support comes from none of these, however, for their resources are very limited, but from an innumerable and unnameable series of sources which have no publicity nor do they seek it. These are learned societies, colleges and institutions, and travel funds, as well as private individuals who come forward with grants so that the expense to the actual members of an expedition shall not be prohibitive.

There has been a small measure of criticism of this somewhat fortuitous method of financing expeditions. It is urged that there would be more efficiency and less wastage if there were some general fund. It is pointed out that expeditions and even parent organizations are liable to become rivals for private favours and public subscriptions.

There are two answers to these criticisms. In the first place, the freedom in the present

arrangement, whereby anyone with a keen desire to explore can find ways and means to do so, is not to be lightly given up. A regimenting of such desire would often strangle it at birth. Secondly, the reason for the support now available is almost always personal. A college or a parent or a travel fund rarely thinks of the abstract cause of exploration or science when it makes a grant; it is considering only the training or the reward of a likely individual. Much of the money now sending young men to live arduously in the polar regions would never be available as a subscription to a General Exploration Fund, however fine its aims or dignified its management. That there is need of a fund of another character will be shown later, but there is no overwhelming case for a general exploration fund for the provision of these junior expeditions.

Next in the list of current criticisms comes the remark sometimes heard that the scientific work is not of a very high order. It is quite true that the range and depth of scientific work on, say, the H. G. Watkins' Expedition to Greenland, was not comparable with that of the Wegener Expedition, there at the same time. This was partly due to a difference of aim and of resources, but mainly of selection, the Germans being established scientific workers of experience and maturity, the Englishmen being beginners or amateurs; in one the object was avowedly scientific, in the other exploration was the chief aim.

Incidentally, it has been suggested in some quarters that in polar exploration science is made the cloak for adventure. This is undoubtedly true to some extent, and some leaders have even been hypocritical about their aims in this respect, in order to get support. Such practices would, of course, defeat their own object in the end; but since it usually means that the scientific workers they do take are doubly keen, one can scarcely say that serious harm is done. In any event, it is open to question whether love of travel can really be divorced from any field-science, and if we elect to regard travel-eagerness as something trifling or unworthy, then we shall have to include Darwin and Wallace in our criticism.

Granting that some of the scientific work done is low in value—inevitable when juniors form so large a proportion of the workers—can we say we are satisfied with the organization of the work and the use made of it?

This is probably the weakest point in the present type of expedition, and there has been a case or two which calls for criticism. To regard a visit to the polar regions as part of a scientific training is well enough, but to take it as the whole training is far from well. There have been instances of young men who, with the sketchiest of training at home, have carried out their investigations in strange places and thereby acquired an authority in their science which is far from sound. This is not confined to the polar regions of course, and in the long run does not necessarily lower the prestige of science. It is not, in our opinion, so vital a criticism as the corollary to it, namely, that a very large proportion of the work done in the field is never published, and much of the collecting is lost to all but a small circle.

The blame for this must be shared between the authorities who lend their support to the expedition, the men themselves, and the scientific public. It is still somewhat unusual to find a leader looking beyond the end of his expedition and considering means of publishing his results. There have been some notable exceptions, and one may be permitted to single out some of the expeditions organized by the Oxford University Exploration Club, which have, by hook or by crook, published fairly full accounts of their work in the proceedings of learned societies. At the same time, some of the less-known expeditions with equally valuable work have been unable to get their work published, from lack of money or influence.

There is, in fact, a very strong case here for a General Publication Fund, the officers or trustees of which would receive applications for aid in publication. Much of the work is best placed in the journals of societies, but some is not quite suitable. The workers themselves should in any event see that their notes, if not published, are preserved in an appropriate place, such as a learned society or the Scott Polar Research Institute.

There is yet another criticism which has appeared in print and should be met. It has been asserted that the parties do not go far enough afield, being limited practically to the longitudes from West Greenland to Spitzbergen. It should be realized that there is not a single part of the Arctic except Arctic Canada which is under the jurisdiction of the British. It is therefore only with the permission of Denmark, Norway and Iceland that these parts have been visited. Those countries have been very generous indeed in the past with permission, and the case for any reluctance they have shown has never been fairly stated on their behalf. They

in common with Canada, have never really objected to properly authorized expeditions with a good and definite purpose. Nevertheless, since they must share some of the responsibility for the safety of the party as well as for the character of the work done, they do insist on support and authorization from responsible bodies. It is to be feared that there have been cases where a body has supported an individual or an expedition without sufficiently careful inquiry into antecedents and suitability for the work.

To sum up, it will have been evident that the post-War spate of polar exploration has been spontaneous and has all the merits and demerits of spontaneity. There is reason for a measure of control in so far as thorough inquiry into prospective expeditions goes, but over-control is likely to dry up the enthusiasm and the freedom of selection which has been such a marked feature of the work.

The authorities who support expeditions are to be congratulated on the results so far; but it is to be hoped they will realize the necessity for a helping as well as a guiding hand in the matter of putting the results gained to the best use. Last and by no means least, our admiration is due to the comparatively small band of leaders of these expeditions who have triumphed over a myriad difficulties even before reaching their goal, and who, when there, have in nearly every case set an example to their men of enthusiasm, hard work and cheerfulness.

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## Protection against Air Raids

**Civil Defence:** a Practical Manual presenting with Working Drawings the Methods required for Adequate Protection against Aerial Attack. By Capt. C. W. Glover. Pp. xx+308. (London: Chapman and Hall, Ltd., 1938.) 15*s*. net.

THE title of Captain Glover's book is somewhat misleading. He has written a manual containing many useful tables, facts, diagrams and illustrations which deal almost entirely with the protection of human beings, and to some extent of animals, against air attack. Civil defence, however, embraces many other urgent problems. The protection of men and women, especially those whose work enables the nation to resist an enemy, is an essential part of civil defence. But the supply of food and the maintenance of transport for its distribution; provision of electricity for essential works; continued output of aircraft; armament and other factories of national importance; the storage and import of oil; and safety and repair of the utility services; all are as much a part of civil defence as the protection of human life. Within this limited aspect, however, Captain Glover deals with many problems; and although the general reader may perhaps be put off by the jazz paper cover, which depicts a nightmare of steel cupolas, underground tube shelters, gas-proof doors and batteries of air filters, the bolder A.R.P. instructors, engineers and workers will find much that will be of use to them in the book.

After a chapter on the probable forms of attack, which includes an interesting statistical summary of the raids made on London in 1915–18, and a description of the various types of bombs and their effect, Captain Glover goes fully into the question of gas. Some 300,000 substances were investigated during the Great War of 1914–18, and of the dozen or so that were adopted as being of practical use, about six were notably successful. Of these, the vesicants, such as mustard gas, caused the greatest casualties per ton used. On an average, it took 500 lb. of H.E. or 60 lb. of mustard to disable one man, but the ratio of deaths to total casualties was twelve times less for gas than for non-gas cases. He therefore deduces that gas warfare is both effective and humane, and must be expected to play an important part in future wars. Details of gas-proof rooms, filter appliances, gas masks, emergency lighting and the cost of the gas and fire-fighting appliances sold by a variety of firms are given.

The second half of the book deals with buildings, trenches and shelters. Of buildings, those which are multi-story, steel-framed or of reinforced concrete are considered the most suitable both for resistance and for containing shelter accommodation. Provided the walls are splinter-proof, that is, 12 inches of ferro-concrete or 14 inches of brick, the ground floor in buildings without basements is recommended as the best level for a shelter, and the stair well gives the greatest protection. But the floor above the shelter must, as in basements, be capable of holding up the debris that may fall on it. The author favours the Swiss standard of strength required for these shelter roofs, which is considerably in excess of

that suggested by the British and German regulations He also adds the concentrated load of 15–20 tons on a circle of 10 inches in diameter. This would only appear applicable in the case of factories and other premises where heavy machinery or fittings may fall from the upper floors.

Two types of lay-out for trenches are given; of these, the zig-zag has been found in Spain to provide greater safety than the crenellated type when considering the radius of damage from a direct hit. In various plates, such as Figs. 70 and 61, the provision of a burster layer, or thick concrete casing which is not bomb-proof, is apt to create a false impression of security. It is a sound principle, where bomb-proof protection against a direct hit cannot be provided, to keep the shelter roof as light as will hold up the splinters and debris that will fall upon it. With trenches in the open, about 18 inches of earth is sufficient. The more there is, the more difficult it is to dig people out in the event of a collapse.

On the subject of dispersal, Captain Glover gives an interesting table which shows that a number of small splinter-proof shelters gives a better chance of safety than a smaller number of larger ones. Prof. J. B. S. Haldane, on the other hand, basing his opinion on statistics and the theory of probability, considers this a fallacy; and in his recent book, "A.R.P.", states that dispersal within a dangerous area does not reduce the probable number of casualties. Mathematically, Prof. Haldane is probably right. But from a psychological point of view, casualties over a large area are less disheartening than very heavy losses in one spot, and from a practical point of view, small dispersed shelters are easier to find or construct than larger ones. In practice, a battalion commander who kept his battalion in mass under long-range bombardment would not remain in command long. Generally speaking, in factories and public shelters, not more than fifty people should be accommodated in one place; where trenches are made, separate ones for each fifty are probably better than a connected system.

Chapter xi gives the responsibilities of the layman and recommendations for the protection of animals. These will be of use to townsmen, but farmers would probably have apoplexy at the suggestion that their farm roads should be concreted to facilitate decontamination and that their pigsties be made gas-proof. The book ends with the Home Office organization of A.R.P., details of various poison gases, a bibliography, and a useful index. E. H. K.

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# Teaching Methods

(1) Interpretation in Teaching
By Dr. I. A. Richards. Pp. xxii + 420. (London: Kegan Paul and Co., Ltd., 1938.) 18*s*. net.

(2) Creative Teaching: Industrial Arts and Vocational Education
By Dr. F. Theodore Struck. Pp. xxv + 623. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938). 17*s*. 6*d*. net.

(1) THE problem with which Dr. Richards deals is one that receives attention in the recent Spens report on secondary schools. The pedantry and formalism of the traditional teaching of grammar and of rhetoric (and to some extent of logic) have done much to kill these subjects as elements in the general curriculum and thus to create a gap which urgently needs filling. Whether or not the exercises of parsing and analysing sentences should be carried out in schools, it is clearly necessary that the art of comprehending and discussing meanings should be acquired in the course of education.

This book has the originality and liveliness which is characteristic of all Dr. Richards's work. He has set problems in comprehension and expression to members of adult classes and discusses the results. From these he draws conclusions as to the natures of the difficulties to be met with in acquiring these arts and the ways of overcoming them.

The book itself is an object lesson in a living method of teaching grammar, rhetoric and logic. Probably most of its exercises are very much too difficult for any except the highest forms in schools; but the intelligent school teacher could easily devise his own exercises on the same principles, suitably graded for the mental ages of his pupils. Dr. Richards makes the interesting suggestion that a valuable exercise in comprehension may be provided by translation into Basic English. It is worth considering whether translation into Basic English might, at smaller cost in school time, provide the advantages to comprehension which have, in the past, been given by translation into Latin.

(2) Dr. Struck's book deals with vocational education. It is didactic, forceful and analytical. The author gives eight characteristics of the progressive teacher, nine objectives of the industrial arts,

eight means of up-grading vocational teachers, and so on.

There is much in this that may profitably stimulate self-criticism in other teachers than those of vocational schools. The book seems to be a summary of the writer's own educational experience, and such a summary by an intelligent teacher is always of value. One wishes, however, that the author had written less of the general problems of teaching and treated rather more fully the special problems of vocational education.

R. H. THOULESS.

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# The Thermionic Valve: Principles and Practice

Moderne Mehrgitter-Elektronenröhren

Von Dr. M. J. O. Strutt. Band 1: Bau, Arbeitsweise, Eigenschaften. Pp. vii + 131. 12.60 gold marks. Band 2: Elektrophysikalische Grundlagen. Pp. v + 144. 13.50 gold marks. (Berlin: Julius Springer, 1937, 1938.)

THE thermionic valve is the classical example—it is even a heavily overworked example—of the everyday implement which sprang directly from the most academic physics. Its development from the useful diode to the revolutionary triode may not have been a calculated development. But the succeeding stages of advance have been guided by the ingenious and meticulous application, clearly reasoned and quantitatively evaluated, of modern physical knowledge. Of the political consequences of these developments, this is not the place to speak. Of the direct economic consequences it is sufficient to quote Dr. Strutt's estimate that a hundred and fifty million multi-electrode receiving valves are in everyday use.

To the progress through tetrode and pentode to the modern octode many nations have contributed, and the relative scientific and technical material is scattered throughout many periodicals. The Philips Laboratories in Holland, with a distinguished record of fundamental research and of technical development, have played a very important part in progress, and the author of this work has made many and notable contributions.

It is, therefore, peculiarly appropriate that the enlightened policy of the Philips concern, and the enthusiasm of Dr. Strutt, should put at our disposal in these two volumes the first connected account of the construction, characteristics and mode of operation of multi-grid receiving tubes, and of the electrophysical principles on which they are designed, computed and operated. Since the reconciliation of research and teaching has never yet been satisfactorily achieved, it would be ungracious to complain that the exposition shows signs of haste, that the arrangement of the material might have been made more logical and convenient, and that the index in particular is ludicrously inadequate and ill-proportioned. When a leader in investigation takes time to write down for us an outline of his principles and practice, he has a right to claim immunity from criticism, alike of his haste to get back to his work and of his anxiety to tell us—however summarily in the later pages of the later volume—of the very interesting things that are in the foreground of his mind as he goes to press. The immunity should not be claimed by his proof-reader, who has done his work well but not perfectly, and a printers' error in the list of printers' errors strains tolerance. But these are small matters.

The first volume, on "Construction, Mode of Operation and Properties", treats these two latter subjects from the point of view of the static characteristics and tube data. In the second volume, on "Electrophysical Principles", the characteristics are derived from the constructional details by the application of the laws of electron-dynamics. This second volume has, as its second purpose, the tracing of the complicated motions of the electrons in multi-grid tubes, as revealed by calculation and measurement, and in particular by measurements in the short-wave region, which are shown to be of special value for the purpose.

Volume 1 is divided into three sections, dealing respectively with high-frequency amplifying tubes, mixing tubes ("The mode of operation of a mixing tube is always this, that the slope of its characteristic varies with the rhythm of the oscillator frequency") and tubes for low-frequency power amplification. The treatment is very generously illustrated by constructional and circuital diagrams, and above all by a wealth of characteristic curves and operational data. These are plotted with a greater variety of parameters, as abscissæ and ordinates, than is usual, and the variety compels the close attention and stimulates the individual thought of the reader.

Volume 2 proceeds from the fundamental equations, with mechanical analogies, through

examination of the electron motions in diodes (without and with treatment of initial velocities, and under the condition of constant emission temperature at the cathode) in triodes and in the ideal tetrode. Static and dynamic tube capacities are discussed, and important and interesting sections are devoted to the characteristic tube admittances in the short-wave region and to dynamic measurements of the electron motions in hexodes, heptodes and octodes. The last few sections include brief examinations of transit-time effects, of the relatively new, rapidly widening and extremely promising field of secondary-emission tubes, of the vital question of fluctuation-noise and the construction of low-noise tubes, and of some important thermal problems in multi-grid receiving tubes. It is significant to observe that the utilization of secondary-emission phenomena has already made commercially available tubes of exceptionally high mutual conductance (14 milliamperes per volt), and tubes of exceptionally low noise-level.

The work is made still more valuable by the use of practical units, by the prominence given to numerical evaluation throughout, and by the provision of a bibliography of approximately three hundred independent entries.

These volumes are indispensable to the circuit designer who wishes to make the best use of the lavish gifts showered on him by the valve-physicist. But it makes good reading for a much less specialized circle; to trace throughout the work the whole story of the octode, its growth from less complex multi-grid tubes, the interactions and secondary effects which must be considered in its design, is an exercise which will impress any physicist with the high quality of the scientific insight and diligence which are so generously and compactly built into the modern multi-grid receiving valve.

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# A Study of Drugs

## A Text-Book of Pharmacognosy

By George Edward Trease. Third edition. Pp. x + 740. (London: Baillière, Tindall and Cox, 1938.) 21*s*.

IT is a far cry from the materia medica of the old days to the modern pharmacognosy. The change has come about largely as a result of the policy of the Pharmaceutical Society of Great Britain in setting this subject on a scientific basis and in demanding a high standard of attainment in it in its qualifying examinations.

The chief exponent of pharmacognosy in Great Britain for some time was the late Prof. H. G. Greenish, who developed the teaching of it at the Society's School of Pharmacy in Bloomsbury Square. He lived just long enough to revise his valued text-book of pharmacognosy in the light of the 1932 edition of the British Pharmacopœia. Since his death, his successor, Mr. T. E. Wallis, has continued to enlarge the scope of pharmacognostical practice, especially in the field of quantitative micro-analysis. Simultaneously, developments have occurred in the schools of pharmacy in British and foreign universities and colleges.

Mr. Trease's book has largely replaced that of Greenish in the teaching institutions. It was first published in 1934 and has gone through two editions in four years. The present edition is fully abreast of the recent advances in pharmacognosy, and much time and thought have been devoted to its production. The complete pharmacognosist is a man of many parts. His preliminary training in botany, zoology, chemistry and physics furnishes him with a foundation on which to build experience in the technique of microscopy, histology, morphology, taxonomy, descriptive botany, plant geography. He learns how drug-yielding plants are cultivated, how the drugs are collected, prepared, exported, stored, marketed. He must know something of their active principles and the chemical tests by which they are recognized, and he must be able to appraise quality, and detect sophistication or substitution, particularly in relation to powdered drugs.

The author has gone to great pains to secure accurate information, and has obtained the help of several collaborators who have special knowledge. He presents his subject-matter in an interesting and readable form, illustrating it where possible by numerous reproductions of photographs, drawings and diagrams. The text-book is of great practical as well as theoretical value. It is almost indispensable to students of pharmacognosy; but the older pharmacists as well as all botanists would do well to peruse it. The publishers also are to be congratulated on a carefully printed and faithfully illustrated volume.

W. O. HOWARTH.

### The Culture of Cities

By Lewis Mumford. Pp. xii + 586 + 32 plates. (London: Martin Secker and Warburg, Ltd., 1938.) 21*s.* net.

MR. MUMFORD is a disciple of Patrick Geddes. In "The Culture of Cities" he applies the principles of his master to the problems of the aggregations of man as city-dweller. He follows the growth of the city community as it has developed in the past, and then sketches the ideal in an essay of constructive reform.

The greater part of his book—that is the first four chapters, covering some three hundred pages—is devoted to the description of the four types into which he classifies cities as examples of communal association, and analyses the various characteristics of each type, tracing their consequences as forces moulding the life and character of the citizen. Of these types, the first is the medieval, which, as the author points out, was never far divorced from the countryside; the second is the city of court and parade, such as Paris under the ancient regime; thirdly comes 'Coketown', the product of the growth of industrialism and the assemblage of some of the most degrading conditions in which man can exist; and lastly 'Megalopolis', the contemporary city of banking and finance.

In this examination of cities of the past and present, Mr. Mumford not only shows himself to be a keen critic and acute analytical thinker, but also he gives evidence of a wide and profitable experience of many men and cities, which he brings to bear rationally on his conception of the ideal in form in relation to the needs of human development. What may perhaps be regarded as the pivotal principle of his conception is the necessity of communal control of the land—a principle to which we seem to be approximating, but with, some may think, fatal deliberation.

### Wild Animals in Britain

By Frances Pitt. (British Nature Library.) Pp. viii + 120 + 68 plates. (London: B. T. Batsford, Ltd., 1938.) 8*s.* 6*d.* net.

THIS addition to the "British Nature Library" is uniform in make-up with Seton Gordon's "Wild Birds of Britain" and Robert Gathorne-Hardy's "Wild Flowers in Britain", and it has attained the same standard of almost unique beauty of production and considerable usefulness.

But the team responsible for the book was almost bound to produce the gem that this is. It is now traditional that a Batsford book on any natural history topic is art and science combined to produce just the right thing. Most of the hundred photographs which adorn the text are by well-known Nature photographers, Millais's "Roe Deer" is reproduced as a frontispiece, and the coloured jacket is by John Nash, whose delightful colour lithographs and line drawings illuminate the companion volume "Wild Flowers in Britain".

The illustrations certainly form the perfect complement to the text of Miss Pitt, who needs no introduction as a writer on natural history subjects. Scarcely a naturalist could have missed reading at least one of her many books, and hundreds of thousands of lay readers must have been charmed by her articles in various periodicals and newspapers. Here, as in all her works, Miss Pitt bases her descriptions chiefly on personal observation, thus making the text not only reliable but also intimate and charming. Anecdote and story mingle with text description in such a way as to give a scientific study which also stimulates friendly feeling towards the lower animals.

The book is deserving of the success which we feel sure lies ahead of it.

### The Chemistry of Synthetic Surface Coatings

By Dr. Wm. Krumbhaar. Pp. 200. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 20*s.* net.

THE chemist is penetrating quite far into the paint industry, partly as the result of the introduction of synthetic materials, with the consequence that a good deal is known about such important subjects as the chemical reactions in the varnish kettle, driers, the surface chemistry of pigments and paints, and the physical chemistry of surface coating. These subjects form the headings of a practical little work by Dr. Krumbhaar, who is himself engaged in the industry in the United States, where the application of all sorts of new coating materials is very much encouraged. A pleasing feature of the book is a number of excellent descriptive photomicrographs.

The new knowledge has even reached the printing ink industry, where the traditional slow-drying linseed oil media are losing ground in favour of quicker drying vehicles based on synthetic resins: a useful chapter is allocated to these developments.

The book will be found both stimulating and informative.

### The Children of Tane

Bird Life in New Zealand. By Mona Gordon. Pp. xii + 250 + 8 plates. (London: J. M. Dent and Sons, Ltd.; Christchurch: Whitcombe and Tombs, Ltd., 1938.) 10*s.* 6*d.* net.

THIS book is written in a slightly romantic vein, making much play with Maori names; but it deals in an interesting manner with bird-life in New Zealand, particularly the forest avifauna and measures for its preservation. The clearance of woodlands has had a very serious effect on the native birds, and this has been aggravated by the introduction of alien species. Fortunately, several islands have been set aside as inviolable sanctuaries, although even on some of these great harm is being done to the vegetation by imported deer or goats.

Each sanctuary is described, with an account of its history and its present state. There are also chapters on such topics as the pollination of plants by birds, flightless birds, and migratory birds—under each of which heads New Zealand provides some remarkable examples.

# Combination Tones in Sound and Light*

By Sir William Bragg, O.M., K.B.E., Pres.R.S.

WHEN two notes are sounded together, the listener may hear in addition other notes which are not overtones of either of the originals. They are combination tones, the frequencies of which are linear algebraic functions of the primaries. Let us denote the latter by $m$ and $n$. The most powerful combination tone has a frequency equal to the difference between $m$ and $n$: a note of frequency $m + n$ is much more difficult to observe. There may be notes of other frequencies, $m + 2n$, $2m + n$ . . . but these are weaker still. A full description of the effect is given by Jeans in "Science and Music", p. 287 *et seq.* It is possible to make experimental arrangements by which the existence of combination tones may be plainly demonstrated. Some of these arrangements are described in the present note.

The subject has had a curious history. Observation must be somewhat close and careful if combination tones are to be heard; this is no doubt the reason why no one described them before Sorge in 1745 and Tartini in 1754. Helmholtz was greatly interested in them and discussed them at length in his famous work on "Sensations of Tone". Koenig strongly opposed the theory which Helmholtz put forward in explanation. The point at issue was whether or no the extra tones were subjective or objective. Helmholtz claimed to have shown by experiment that they caused a response in tuned resonators; Koenig asserted that they had their origin only in the listener's ear. A number of other experimenters joined in the discussion. Lord Rayleigh, Waetzman, Edser and Rucker supported Helmholtz, while Preyer and Bosanquet sided with Koenig. Ellis, in the second edition of his translation of Helmholtz's book, devoted a long chapter to a reasoned comparison of the two theories.

In view of the vigour of the disputation it is strange to observe that, when certain conditions are satisfied, combination tones must have a real objective existence in the sense that resonators can be tuned to them. It is also true that, as Helmholtz pointed out, they can be generated within the ear, on account of the ear's peculiar structure. Certain preliminary conditions must be satisfied if the tones are to be objective, and it would seem that the long controversy was maintained by failure to realize those conditions in all cases.

The discussion at last died away. It was not even referred to when fifty years later an exactly analogous problem was met with in wireless telephony and the discussion was repeated in full. The so-called side bands are combinations of the carrier wave and the audio wave, and in the sense already described, have just as real an existence[1]. Still later, the phenomenon has been found again in the peculiar scattering of light known as the Raman effect.

The underlying principle is very simple. When vibrations of two different frequencies are imposed upon a medium as, for example, when two tuning forks are sounded, the chord consists only of the imposed frequencies and there are no combination tones in the air. But if during the production of sound the amplitude of one source depends at every instant upon the amplitude of the other, the combinational tones appear. In the first case the disturbance in the medium may be represented by

$$a \sin 2\pi mt + b \sin 2\pi nt.$$

In the second, there is sure to be a term of the form:

$$2c. \sin 2\pi mt \times \sin 2\pi nt,$$

which is equal to

$$c. \cos 2\pi (m-n)t - c.\cos 2\pi(m+n)t,$$

and the combinational tones have an objective existence.

This conclusion is readily illustrated by experiment. In Fig. 1, $A$ represents a coil seen edgeways, through which either a steady current $a$, or an alternating current $a \sin 2\pi mt$ can be made to run. $B$ is a smaller coil at right angles to $A$: the centres of the two coils coincide. Through the second coil, either a steady current $b$ or an alternating current $b \sin 2\pi nt$ may be made to run. The second coil can turn about a vertical axis which is perpendicular to the plane of the diagram. $T$ is a cylindrical tube in which a slider $s$ is mounted; the slider contains a piezo-electric microphone connected to a loud speaker. When $B$ vibrates about its axis, which it must do if there are currents in the coils and one or both are alternating, the disk $D$ flutters before the mouth of the tube. The tube, as a resonator, can be tuned by moving the slider.

* Friday evening discourse delivered at the Royal Institution on November 11.

In an actual experiment, the current of frequency $m = 250$ was taken from a high-frequency generator, that of frequency $n = 50$ was drawn from the lighting circuit. When the current in $A$ was alternating and that in $B$ was steady, the resonator responded to the 250 note. When the current in $B$ was alternating, the response to the 250 note became much weaker but the resonator could be made to respond strongly to either 200 or 300. The torque on the $B$ coil was proportional to

$$\sin 2\pi.\ 250.\ t \times \sin 2\pi.\ 50.\ t,$$
$$\text{that is, to } \cos 2\pi.\ 200.\ t - \cos 2\pi.\ 300.\ t.$$

The difference tone should be the stronger, other things being equal, because the equation of motion of the $B$ coil may be written

$$K.\ \ddot{\theta} = -c\left\{\cos 2\pi(m-n)t - \cos 2\pi(m+n)t\right\},$$

where $\theta$ is the angular displacement and $K$ is the moment of inertia of the coil and $c$ is a constant; so that

$$K.\ \theta = \frac{c}{4\pi^2}\left\{\frac{\cos\ 2\pi(m-n)t}{(m-n)^2} - \frac{\cos\ 2\pi(m+n)t}{(m+n)^2}\right\}.$$

The movement of the disk at the mouth of the resonator can therefore be analysed into two harmonic terms, one of them having a frequency $m - n$ and an amplitude proportional to $1/(m-n)^2$, the other a frequency $m + n$ and an amplitude proportional to $1/(m + n)^2$. The response of the piezo-electric microphone, and the other electric and acoustic transformations of the energy which take place before the sound leaves the loud-speaker will alter the relative intensities of the two sounds, and will even introduce fresh combination tones; but the main effect is so pronounced that the verification of the theory is quite clear.

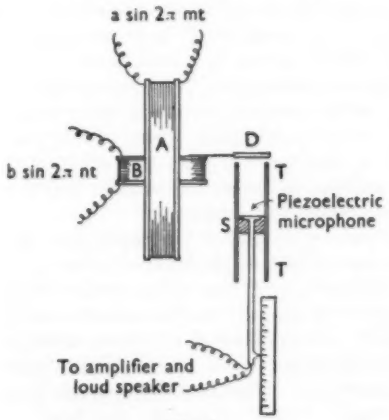


Fig. 1.

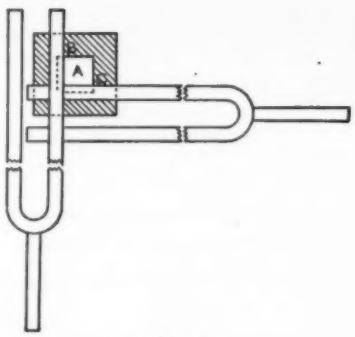


Fig. 2.

An effect depending on the multiplication of harmonic terms can also be shown in a second way (Fig. 2). The light which passes through a small square aperture in a screen is brought to a focus at a place marked $A$ in the diagram. It is there partly intercepted by two tuning forks which are at right angles to one another. The beam of light is thereby restricted to a rectangle of which the sides may be denoted when the forks are vibrating by

$$a + b \sin 2\pi mt \quad \text{and} \quad c + d \sin 2\pi nt.$$

The intensity of the light which passes on is therefore proportional to the product of these two expressions; and this product contains the term $bd \sin 2\pi mt . \sin 2\pi nt$. The light falls on a photo-cell and produces an effect which is transformed into sound. The latter can be analysed by the piezo-electric resonator used in the first experiment. It is found to contain the frequencies $m$, $n$, $m - n$ and $m + n$.

If the two tuning forks are placed parallel to each other, the intensity of the transmitted light is proportional to $a + b + c \sin 2\pi mt + d \sin 2\pi nt$ and there are no combination tones due to the optical arrangement. There may be, however, faint combination tones due to the subsequent treatment of the energy in the detecting apparatus.

The way in which a detecting apparatus can generate accessory tones may be illustrated by the following example (Fig. 3). Suppose that a piezo-electric cell is inserted at the end of a short cylinder, and that a piston executes a harmonic motion, so that the volume of the air may be put equal to $v = v_0 + v' \sin 2\pi mt$. Then the pressure $p$, supposing the motion to be isothermal (though

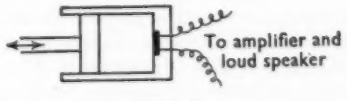


Fig. 3.

it makes no difference to the general result if it be taken as adiabatic) is given by $pv = c$, a constant.

$$\text{Therefore, } p = \frac{c}{v_0 + v' \sin 2\pi mt} = \frac{c}{v_0}\left(1 + \frac{v' \sin 2\pi mt}{v_0}\right)^{-1};$$

and this when expanded shows overtones, although the piston itself moves in a simple harmonic motion.

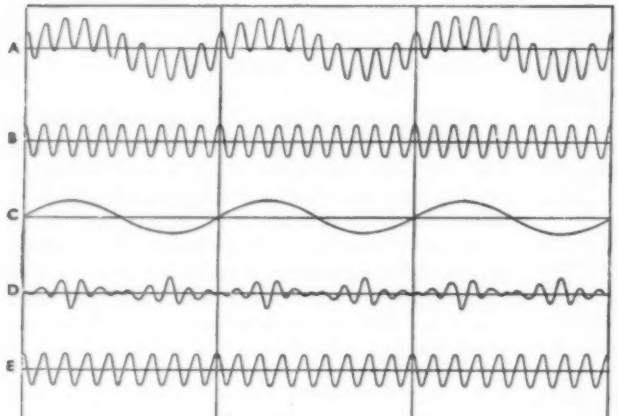


Fig. 4.

If there are two pistons operating on the one chamber,

$$p = \frac{c}{v_0}\left\{1 + \frac{v' \sin 2\pi mt}{v_0} + \frac{v'' \sin 2\pi nt}{v_0}\right\}^{-1};$$

and this when expanded shows a system of combination tones.

The variations of pressure can be converted into a complex sound in which the tones appear.

When a tuning fork is held before the mouth of the resonating tube used in the first experiment, the octave overtone is readily found.

When two notes are sounded on a harmonium or organ, combination tones are generally heard, though some people find a difficulty, especially at first. The combination tones of a harmonium at the Royal Institution are greatly intensified when a microphone is placed on the case of the instrument and connected to a loud-speaker. The combination tones of harmonium and organ would seem to be due to modulation, as in the simple instance just given. The pistons of the model are in the actuality replaced by the to and fro surges of air from the sounding pipes or reeds. It seems that in the instance just given the combination tones are of greater importance in the vibrations of the woodwork of the chest than in the air outside.

In the radio transmission of sound, modulation is a necessity. Sound waves can be converted directly into electrical oscillations of similar frequency, but it is practically impossible to put into such slow oscillations sufficient energy for effective transmission. Hence a carrier wave of high frequency is employed which is modulated by sound waves and carries to the receiving station the impressions which have been made upon it. The form of the modulated wave can be represented in the customary way by such a figure as the curve $D$ in Fig. 4, which may be described—approximately only—as a disturbance having a periodicity equal to that of the carrier wave, and an amplitude which varies in accordance with the impressions made by sound at the transmitting end. Strictly speaking, the disturbance is the sum of a number of different waves. One of them has the frequency of the carrier wave, and is as a matter of fact useless. Others are combination tones, and these are the real carriers; and there are other derivatives present in relatively weak amount.

In Fig. 4, the harmonic curve $B$ may be taken to represent the carrier wave, that is to say, the ether wave due to the oscillator of the transmitting station, and $C$ the ether wave into which a harmonic sound is transmitted. The frequency of $B$ is ten times that of $C$; in practice, the factor is very much larger. If the disturbances were merely added as represented by the curve $A$, the two would be quite independent in their effects at a receiving station: the wave $B$ would be detected just as if there were no wave $C$, and would convey nothing. The wave $C$ would be too faint for perception. But if by proper manipulation at the sending station a wave is produced which is the continuous product of $B$ and $C$, as shown in the curve $D$, then the effect of $C$ on $B$ is detected at the receiving station, that is to say, the sound signal is received.

The curves $E$ and $F$ are harmonic curves of frequencies nine and eleven times that of $C$, being the difference and sum respectively of the frequencies of $B$ and $C$; and $D$ can also be obtained by adding $E$ and $F$ together. The receiving station can detect these two separately. They are combination tones. Technically they are known as 'side-bands'.

The Raman effect is based on the same principle.

The incident light of definite frequency excites a forced vibration of the same frequency upon the molecule which it meets. If the magnitude of the response to the impressed electric force depends upon some quantity in the molecule which is undergoing harmonic oscillations, as for example some relative oscillation of the atoms in the molecule, modulation occurs. Lines representing combination tones are found on each side of the line representing the original frequency in the spectrum of the scattered light.

[1] Hasel, *Phil. Mag.*, **19**, 103 (1935).

# Some Scientific Researches in the Region of Mount Everest

By N. E. Odell

ANOTHER expedition to Mount Everest has returned, with the primary object still unattained. As in the case of the four previous main attempts (1921 and 1935 were reconnaissances), the weather conditions, associated last year particularly with a very early monsoon, must be held chiefly responsible for a further failure to reach the top of the world's highest summit. While understood to be essentially a mountaineering expedition, in the intervals of strenuously pursuing the main objective an effort was made by two members of last year's party to carry out a certain amount of scientific work. It is much to be regretted that such work, on the more recent expeditions to Everest, has been in no way encouraged, but rather discouraged, by those responsible both for their organization and their leadership.

During the 1938 expedition, I had the opportunity of continuing the geological work commenced during the Expedition of 1924, and furthered by L. R. Wager in 1933[1]. A. M. Heron, of the Geological Survey of India, had on the first Expedition of 1921 mapped geologically the Tibetan area lying to the north of the Everest Massif[2], but the stratigraphy and structure of the main Himalayan chain hereabouts was left to his successors. In 1924, a detailed study of the crystalline complex of the main range in particular was commenced by me, and I published a provisional geological map of the district surrounding Everest itself[3]. This work was continued during last year's Expedition, and an extensive collection was made of the various petrological types representative of the metamorphic series of the district. It is a tragedy that on the return journey almost the entire collection was stolen from one of our camps by Tibetan natives, the theft being presumably in mistake for the cash-box! However, with material collected in 1924, as well as by Wager in 1933, a comprehensive study is now being made of this particular region, although there must necessarily be gaps caused by the above irreparable loss. From the information available, it is hoped that it will soon be possible to give a fair, though incomplete, account of the stratigraphy and age, as well as the ruling structures, of this complicated and inaccessible portion of the Himalaya.

Briefly, the age of the Everest stratified series is not younger than Permo-Carboniferous, while the intrusive granitic rocks are probably Tertiary, and date from the movements of that age, both horizontal and vertical, which have given rise to such pronounced structures as the Everest Thrust Fault (discovered last year on the south side of Everest), and the great fault-scarps confronting Tibet in many places along the northern flank of the main chain. There is, however, much important work yet to be done on these problems.

As to glaciological observations upon the unusual glaciers of this greatly elevated yet nearly tropical region, a start only has so far been made. Unlike the glaciers of the temperate zone, those of the Everest region appear to be frozen throughout their mass, a physical condition which places them in the category of 'high polar' glaciers (Ahlmann). This condition would seem to give rise to a greater brittleness and a tendency, as in the polar regions, for the glaciers to move more by fracture and shear than by what approximates to viscous flow. Not more than rough measures of the speed of these glaciers have as yet been made. Another point of interest is that the steeply inclined solar rays and intense insolation, together with a high rate of evaporation consequent upon the great altitude, give rise to remarkable and unusual wastage effects on the surface of these glaciers, of which the giant ice-pinnacles, and other *penitente* forms are examples. These same factors, coupled with the condition of the ice, have given rise to the very peculiar 'troughs', veritable ice-valleys, that are such a remarkable feature of the glaciers of the northern side of the Himalaya.

The present glaciers appear to be in a state of stagnancy, or possibly extremely slow retreat. That they once extended much farther down their

valleys is clear from the evidence of moraine-shelves along the Rongbuk valley and elsewhere. These consist of four lateral moraines, or discontinuous portions of them, one above the other, occurring at heights of from 400 ft. to 800 ft. above the valley-floor. Whether these glaciers, during the maximum Pleistocene glacierization of the region, debouched far out towards the Tibetan plains is not, from the available evidence, at present certain.

As to the study of the widespread post-glacial gravels along the southern border of the plains, and the extensive valley-terracing in the drainage-basin of the Arun River, an immense field lies open for further research. Wager[4] has discussed the evidence of warped terraces and its possible significance in the tectonic history of the region; and it was a matter for the greatest regret that I was prevented last year from continuing the work upon this very important problem. In the valley of the Chiblung Chu and elsewhere, however, data were collected which suggest that much of the terracing in those areas may have been due to climatic rejuvenation, consequent upon Pleistocene conditions, rather than to tectonic.

Apart from the usual temperature and other meteorological observations, particular attention was paid in 1938 to determinations of relative humidity with an Assmann psychrometer, kindly lent by the Meteorological Office. In the light of the findings of G. Seligman that under Alpine conditions 85 per cent relative humidity constitutes a critical point at which wind-slab avalanches may take place, an attempt was made to test the theory under high Himalayan conditions, and especially on the slopes of the North Col. Under the difficult conditions of last year, however, no satisfactory conclusion was reached. Moreover, it had been hoped to bring into use a special high-speed anemometer and so obtain for the first time quantitative values of the wind velocity across the face of Everest. But the exceptionally early arrival of the monsoon, before we had actually reached the North Col, prevented this being done.

In spite of a good deal of preoccupation with illness on the Expedition, and apart from his being a member of the climbing party, Dr. Charles Warren was able in 1938 to collect further physiological data to amplify that obtained by his predecessors. This is now being examined, in particular samples of alveolar air, and the results will be published in due course. Specialists in this branch of science will be the first to admit that a vast amount of additional data is required before anything like a full understanding of many aspects of high-altitude physiology can be obtained.

The foregoing outline of researches attempted and accomplished, often under the greatest difficulties, should, it is hoped, be sufficient to indicate that much valuable work remains to be done by future Mount Everest expeditions. The only branch of scientific investigation that can be said in any way to have been completed is the topographical mapping, which was commenced by the Indian Survey detachment in 1921, continued in 1922 and 1924, and concluded locally in 1935 by photogrammetric methods. The field data obtained in 1935 have, however, yet to be worked up cartographically. That there is still an enormous field for scientific endeavour in this unique and little visited region must be realized when it is stated that geophysical and archæological researches have so far never been attempted there. As far as geophysics is concerned, we are in complete ignorance as yet in regard to the state of gravity on the high plateau of Tibet. A very few determinations of the force of gravity would help us in understanding how that immense tract remains in such an elevated position without, apparently, the support inherent in folded mountain ranges themselves. A couple of trained observers for this particular purpose would be all that are necessary. Moreover, observations of terrestrial magnetism would be of great interest and value, and would amplify the important results of this kind recently obtained by Dr. Wienert of the (German) Schäfer Scientific Expedition, now working in the neighbouring territory of Sikkim and Tibet[5], apart from those embodied in the extensive magnetic survey across Central Asia by W. Filchner during the last twelve years[6].

As to archæological research, along the route through southern Tibet one sees relics of many ruined mud-walled towns and villages, quite different in style of architecture from present buildings and dating back without doubt hundreds of years. Many of these structures suggest fortification, and there appears to be much in their character to recall the 'limes' (forts) of eastern Sinkiang, as described by Sir Aurel Stein. The study of these would clearly yield results of great ethnographical and historical value, and amplify the work of Sven Hedin north of the Tsangpo River.

In addition to the above studies, a large amount of important ecological and other work in natural history remains to be done. Indeed no real naturalist has accompanied the Everest expeditions since 1924.

The objection of native prejudice, that is in some quarters brought forward against scientific work on these expeditions, has often been unduly exaggerated, especially in regard to geology. For actually, at various places in Tibet, both lay and ecclesiastical members of the community have

sometimes offered fossils and other odd rock specimens for sale to members of the expeditions. With due tact and care it is quite easy in the pursuit of one's investigations to avoid offending the more unenlightened elements of a people who still largely live in an atmosphere of the Middle Ages, and who have cogently declared that Western civilization can do nothing for them but promote unhappiness.

[1] Ruttledge, "Everest 1933", 312.
[2] Heron, *Geog. J.*, **59**, 418 (1922).
[3] Odell, *ibid.*, **66**, 289 (1925).
[4] Wager, *ibid.*, **89**, 239 (1937).
[5] Personal communication.
[6] Filchner, *Geog. J.*, **92**, 60 (1938).

# Obituary Notices

## Prof. E. B. Wilson, For.Mem.R.S.

BY the death on March 3 of Prof. E. B. Wilson, the United States has lost her foremost zoologist. During his long tenure of the professorship in Columbia University he made some outstanding discoveries in his science. He studied the growth and structure of the so-called 'trochophore' larva which is specially characteristic of the annelid worms. It is also found in the Mollusca, a group widely divergent in structure from the worms. Further, it occurs in the Polyzoa Entoprocta and Phorerudea, and in a modified form it is seen in the Nemertinea. There can be no doubt that it represents in modified form the common ancestor from which all these groups diverged. If we put them all together, we see that in this way the origin of a large proportion of the Invertebrata is accounted for.

Prof. Wilson introduced the conception of 'cell-lineage' into embryology. By this is meant the study of the growth of a particular cell in the cleaving egg until it gives rise to an organ in the fully developed trochophore. He recognized two types of cell lineage which he termed respectively "determinate" and "indeterminate" cell-lineage. In the former type, which is characteristic of the trochophore group, each particular cell of the egg gives rise to a particular organ. The latter type is characteristic of the Coelenterata and Echinodermata. In this type up to a certain stage in the cleavage the cells are equipotential, that is, each of them can give rise to the whole organism.

In his later years, Prof. Wilson took up the study of the growth of the nucleus, because this is the sole carrier of heredity. This is proved by the case of the mammalian spermatozoon, which consists merely of a nucleus but which transmits all the characters of the father to the young organism. Prof. Wilson had as his colleague in Columbia University Prof. T. H. Morgan, whose famous theory of the chromosomes swept over America like a whirlwind. This theory was based on studies of the fruit-fly, *Drosophila*, and professors of "drosophily" have actually been appointed in some American universities. Wilson accepted with some reservations his friend's chromosome theory; but he was more conservative than Morgan, and refused to associate special characters with particular bits of chromosome. In 1913, Wilson received the honour of an invitation to deliver the Croonian Lecture to the Royal Society, and he chose chromosomes as his subject.

Wilson's influence on the course of the study of embryology was very great. A large band of young workers in both the United States and Europe continued and extended his studies in cell-lineage. My own acquaintance with Wilson extended over a considerable number of years. I first met him in Naples in 1892 when we were fellow students in the Zoological Station. Afterwards, I met him in the United States when we were both members of the American Society of Zoologists and I was professor at McGill University in Montreal, a few miles from the American border. His ill-health and subsequent death were due to a tragic accident which befell him when he was conducting a body of students, men and women, on a cruise up the Pacific coast of Canada. On the return journey the boat struck a rock and foundered. Some of the students were drowned and others, including Wilson, had to spend hours in the icy water before being rescued. From this exposure, Wilson contracted rheumatism, which crippled him during the remainder of his life and ultimately led to his death. It is too sad to think of the additional work which he might have done had this accident not occurred.

E. W. MACBRIDE.

## Prof. A. P. Coleman, F.R.S.

THE death of Prof. A. P. Coleman, emeritus professor of geology in the University of Toronto, will be regretted by all geologists, for he was one of the few remaining representatives of that school of teachers who had received their early training at a time when geology was still a self-contained study and had not differentiated into the varieties of interest that now divide us.

Born at Lachute, Quebec, and educated at Victoria University, Coburg, Canada, Coleman proceeded, as did many Canadians at that time, to Germany, where he obtained the Ph.D. degree of Breslau. On his return to Canada he was made professor of geology and natural history at his old University in 1888, and remained there until 1890 when he was appointed to the University of Toronto. His ability was early recognized both in England and in North America as is shown by, among other distinctions, his election to

the Royal Society, the award of the Murchison Medal of the Geological Society of London and the Penrose Medal of the Geological Society of America.

Like all of his generation, Coleman's geological interest was wide, and we have from his pen papers dealing with such contrasted subjects as ore deposits and palæontology, pre-Cambrian stratigraphy and Pleistocene geology. Wide as was the scope of his work, however, it is probable that he will be remembered most for two outstanding studies, the geology of the great nickel ore-field of Sudbury, Ontario, and the evidence and history of past ice ages. The mapping of the Sudbury district involved much more than a study of the ores themselves, for it necessitated the unravelling of the geological history of a most complicated series of pre-Cambrian strata which in its turn had far-reaching effects on the interpretation of the structure of the "Canadian Shield" as a whole. Notwithstanding the great amount of work that has been done in this area by the geologists of the Dominion Geological Survey, the Ontario Department of Mines and the International Nickel Co., there has been substantially no change made in the rock groups that Coleman differentiated in his map and report of 1913.

In assessing the merit of this study one has also to remember the conditions under which it was executed. When Coleman entered the field it was still the typical wilderness of northern Canada, without roads of any kind and, in much of the area, without even trails. Owing to the somewhat unusual topography also, canoeing did not provide that ready means of access which is common in Ontario and Quebec, so that Coleman had to carry his survey through mostly on foot. Notwithstanding these difficulties his map has survived the exacting demands made on it by mining engineer and prospector, and the only change of any moment has been the recognition of faulting in the south-western corner. Some more significant alterations have been made, however, in his interpretation of the origin of the ores themselves, and there are few geologists now working in the district who would accept his theory of the formation of the sulphides by liquation from the adjacent norite either through the action of gravity or by some form of filter-pressing.

In his other important study, that of the past ice ages, Coleman was the first to present conclusive evidence of the glacial origin of the Cobalt conglomerate and to show its similarities with Pleistocene glaciation. He was convinced that the tillite could be traced as a definite horizon throughout the Huronian rocks of Ontario, but some doubt has been cast on this thesis by Collins's identification of the Ramsay Lake conglomerate as an ancient regolith.

No reference to Coleman's work would be complete without a mention of his love for travel and exploration. He made a point of seeing for himself the most significant features of world geology and to this end travelled much in Europe, Africa, India, Australia and North and South America. It is this immediate familiarity with the field observations that is reflected in his most interesting book on "Ice Ages, Recent and Ancient" published in 1926, and one can well guess that it was from the same source that he derived that enthusiasm that made him so highly esteemed and successful a professor in Toronto. He also had the happy gift of portraying the scenes he had visited with water-colour sketches, one of special interest being probably the earliest picture we have of Mystery Mountain (Mt. Waddington) in the Coast Range of British Columbia. He did not restrict his painting to scenery alone but also applied it, in dramatic fashion, to the illustration of his theories of ore genesis.

T. C. PHEMISTER.

## Dr. Louis Fabry

WE regret to announce the death of Louis Fabry, the well-known French astronomer. He was born in 1862 and belonged to a family that has given eminent men of science to their country, one brother, Prof. Charles Fabry, being the renowned physicist; another brother, Prof. Eugene Fabry, is a mathematician of repute.

At the early age of sixteen years, Louis Fabry received the degree of Bachelier ès sciences, and after various other academic distinctions he was appointed to the Observatory of Paris in 1884 as a student astronomer. Two years later he went as assistant astronomer to the Observatory of Nice, and in 1890 he took up work at Marseilles Observatory, from which he retired fourteen years ago.

Fabry's interests in astronomy were very wide and he wrote on a diversity of astronomical matters. In 1893 he was awarded the degree of Docteur ès sciences mathematiques for his thesis presented before the Faculty of Sciences in Paris, in which he showed that the absence of strongly hyperbolic orbits among the comets proved that these bodies were members of the solar system. In 1899 he dealt with the influence of his theory of cometary orbits on the hypotheses of cosmogony, and showed that the attraction of the distant stars and the lack of homogeneity in the primitive nebula, although not very considerable, were, nevertheless, not without influence, and their simultaneous intervention was sufficient to explain both the rotation of the sun and also the direct motion of the planets. In addition, these factors were responsible for causing the comets to deviate from the line which would make them fall towards the centre of the nebula, that is, the sun, and so prevented them from possessing perihelion distances that would otherwise have been practically zero.

Fabry did much useful work on minor planets, in particular, in the compilation of tables for facilitating the computation of ephemerides. The improvement of orbits by means of four observations is a well-known method but it involves rather complicated algebraic calculations. Fabry partly overcame this difficulty by means of new differential formulæ which introduced considerable simplifications in the solution of the problem. The method was later applied with great success by other computers. His tables on the perturbations of minor planets with small eccentricity and also small inclination proved very effective for the computation of the orbits and

ephemerides of these bodies. Amongst his other lines of research may be mentioned his work on refraction, his tables for the determination of the geographical visibility, measurement of altitudes by the barometer, studies in certain problems of seismology, and also his zenithal apparatus, described in the *Bulletin astronomique*, **12**, 148, which was capable of making observations simultaneously of the zenith and stars in the vicinity. He was four times awarded prizes by the Paris Academy of Sciences. Astronomical science has lost one whose versatility contributed so much to its progress. M. D.

## Prof. N. V. Nassonov

PROF. NICOLAI VICTOROVICH NASSONOV, who has recently died in Leningrad, was the oldest member of the Russian (now U.S.S.R.) Academy of Sciences. He was born at Moscow on February 27, 1855, and in 1874 entered the University of Moscow where he studied under the well-known zoologist, Prof. A. P. Bogdanov, and on obtaining his degree was appointed an assistant and later a lecturer at the Zoological Museum of the University. In 1889, Nassonov joined the University of Warsaw and a year later was appointed to the chair of zoology. In 1909 the Academy of Sciences elected him to membership and he was called to the post of the director of the Academy's Zoological Museum at St. Petersburg. A strenuous period of reorganizing the Museum occupied his time until 1921, when he became director of the Special Zoological Laboratory of the Academy which had been founded by the famous A. O. Kovalevsky. By 1925 this Laboratory, which at first occupied three rooms and had a staff of three men of science, had developed into a large Laboratory of Experimental Zoology and Animal Morphology. It was only in 1935, when eighty years of age, that N. V. Nassonov was persuaded by his medical advisers to retire from active administrative work, but even then he continued researches on regeneration until his death.

The published works of N. V. Nassonov are more than a hundred and seventy in number and deal with a variety of subjects. His earlier morphological work was mainly done on insects and other Arthropoda (ants, Strepsiptera), but later he produced excellent papers on sponges (Clionidæ), on the development of the ostrich, on the anatomy and systematics of Turbellaria, a monograph of the wild sheep of the Old World, to mention but some of the problems investigated by him with painstaking accuracy and discussed with a broad evolutionary outlook. During the latest period of his work at the Zoological Laboratory, N. V. Nassonov concentrated his attention on regeneration problems, and published a series of outstanding contributions dealing with physiological factors of regeneration, with the morphogenetic function of cartilage, etc.

N. V. Nassonov was well known beyond the borders of his own country, since at various times he visited and worked at the biological stations at Trieste, Marseilles, in the museums in London (1913) and Berlin, and carried out expeditions to Egypt, Sinai and Japan.

N. V. Nassonov's death means the loss of one of the oldest generation of Russian men of science who in the second half of the last century laid the foundation for the development of biological sciences in that country, and whose work served to create for Russian biology an honoured place in the front rank of world science. B. P. UVAROV.

## Prof. H. A. Cummins, C.M.G.

WE regret to announce the death of Prof. Henry Alfred Cummins, emeritus professor of botany in the University College, Cork. He was a member of a family prominent in Cork medical and university life. An elder brother was professor of medicine in the same College.

Cummins was born in 1864. Having taken the M.D. degree in the Royal (now National) University of Ireland, he joined the Royal Army Medical Corps, and was immediately plunged into a series of campaigns. He served in the Sikkim Expedition (1888), Ashanti (1895–96) and in the South African War (1899–1901), during which he was mentioned in dispatches. On the outbreak of the Great War he was recalled for service with the R.A.M.C., and was again mentioned in dispatches. During his military career, he cultivated a keen taste for botany, and managed to collect specimens wherever he might be, even going so far as to shoot epiphytes, otherwise inaccessible, from high forest trees.

In 1909, shortly after his retirement as Major, Cummins was appointed professor of botany in University College, Cork, a constituent college of the National University of Ireland. He held this position until 1931.

Cummins had a personality of considerable charm. He followed his original interests in spermaphytes with histology and cytology. Just before his retirement, he carried out experiments on the reclamation of estuarine shores near Cork by means of the rice grass, *Spartina Townsendii*. These appear to have been the first attempts at such reclamation in Ireland.

J. C. SPERRIN-JOHNSON.

WE regret to announce the following deaths:

Prof. F. J. Cheshire, C.B.E., formerly director of the Optical Engineering Department, Imperial College of Science, London, on March 24, aged seventy-eight years.

Prof. Vasili Y. Danilevsky, of Kharkov, known for his work in physiology and endocrinology, on February 25, aged eighty-seven years.

Mr. L. J. Newman, Government entomologist of Western Australia, on December 8, aged sixty years.

Baron Joji Sakurai, honorary professor of chemistry in the Imperial University of Tokyo, president of the Imperial Academy and the National Research Council of Japan, on January 28, aged eighty years.

Prof. John H. Schaffner, professor of botany in the Ohio State University, an authority on the taxonomy and phylogeny of the Ohio and Kansas flora, on January 27, aged fifty-five years.

# News and Views

## Social Relations of Science

FOR many years past, the columns of NATURE have borne witness to the growing importance of science in everyday life, and the corollary that men of science should interest themselves actively in the social implications of their discoveries has been frequently urged. That they are not indifferent to the movement was apparent from the discussion on the subject in NATURE of April 23, 1938, and from the decision, taken by the General Committee of the British Association at the Cambridge meeting last summer, to establish a Division for the Social and International Relations of Science. The circumstances of the formation of the Division are stated in NATURE of August 27, 1938, p. 380. It was very appropriate that the first chairman of the new Division should be Sir Richard Gregory, who was editor of NATURE when the subject was discussed in these columns, and it was equally appropriate that he should open the first public meeting of the Division, held in the University of Reading on March 28, when various aspects of the utilization and production of milk were described by half a dozen leading authorities. The highly controversial subject of pasteurization received a considerable amount of attention, and rightly so, for it is with such problems, involving scientific, economic and even political issues, that the Division may be expected to deal. Indeed, one of the prime reasons for the existence of the Division, namely, the need, in controversial issues, for propaganda based on scientific facts rather than personal points of views was well exemplified by this first meeting. It was announced that further meetings of the Division are being arranged to be held in London in May and in Manchester in June.

## Henry Edward Armstrong Memorial Fund

IT is proposed to establish a Trust Fund to the memory of the late Prof. Henry E. Armstrong. At the Finsbury Technical College, and later at the Central College, South Kensington, Armstrong and his co-workers, Ayrton and Perry, tried out and established the principles of technical education in Great Britain, and thus encouraged the foundation of polytechnics and technical colleges throughout the realm. Friends, old colleagues and past students have decided to establish a Trust Fund to perpetuate the memory of his dynamic personality. The aim, financially, is a modest one, so that all, including those who met him in other walks of life, may feel that they are contributing an integral part to the memorial whatever the dimensions of their individual contribution. The hope is for a memorial fund totalling about £3,000. This will provide a guarantee fund to give, as it accumulates, sufficient to ensure the publication (or to give substantial financial assistance in the publication or preparation) of any original works, within the ambit of Prof. Armstrong's recognized interests, that would not otherwise see the light of day. It will also be within the terms of the Trust to arrange for suitable public lectures by the authors of the works. An additional detail of the plan is that the publication itself will carry as frontispiece a portrait of Prof. Armstrong, a biographical note and a reference to the foundation and objects of the Trust. Furthermore, the fund will provide for a memorial plaque, or bust, for the City and Guilds College, South Kensington, and perhaps replicas elsewhere. The administration of the fund, it is proposed, shall be undertaken by six persons, one each from the Council of the Royal Institution of Great Britain; the Royal Society; the City and Guilds of London's Institute; the Royal Society of Arts: one additional member whom the above representatives may appoint and the author of the most recent work published under the Trust. Subscriptions should be sent to the Hon. Treasurer, Sir Alfred Chatterton, The Coppice, Beckenham, Kent.

## The Gatty Marine Laboratory, St. Andrews

MARINE biologists will be pleased to learn that preparations are being made to reopen the Gatty Marine Laboratory at St. Andrews, and that it is hoped to have it in full working order when the British Association meets at Dundee this year. The laboratory, which has been closed for some twenty years, was built in 1896 and presented to the University by Dr. C. H. Gatty. It replaced the wooden building (previously a fever hospital) on an adjacent site where the late Prof. W. C. M'Intosh established in 1884 the first permanent marine laboratory in Great Britain. St. Andrews has been a classic ground for the marine naturalist ever since the time of Edward Forbes, nearly a century ago. It is true that with the decay of the local fishing industry and the increasing pollution of the inshore waters due to the growth of the city the facilities for collecting are not so good as they used to be; but the interest of the locality is by no means exhausted. It is to be hoped that Sir D'Arcy Thompson and Prof. R. J. D. Graham will be adequately supported in their efforts to make St. Andrews once again a centre of teaching and research in all that concerns the life of the sea.

## Economic Aspects of Defence

A PAMPHLET, "Economic Aspects of Defence", by Mr. Harold Macmillan, M.P., directs attention to the economic factors which are involved in our present rearmament programme and to the futility of rearmament unless it is accompanied by an adequate foreign policy (London: Macmillan and Co., Ltd., 1939. 1*s.* net). In this respect, he is highly critical of the Government policy urging that as a result Britain has been growing weaker instead of stronger during the period of rearmament, and he urges that the first

step in the building up of our defence policy should be to recreate as quickly as possible the alliance of peace-loving powers in the League of Nations. He also urges the importance in rearmament of simultaneous attention to the problem of unemployment. By a full utilization of the labour-power of those now unemployed and by the elimination of waste due to competitive redundancy in production and distribution, we could increase our production of armaments and of consumers' goods as well. The available labour power and capital resources of the nation should be distributed according to a plan of increased national productivity. Defence preparations, he insists, involve consideration of overseas trade and our general economic relations with other countries; the productive efficiency of our economic system as a whole; the accumulation of supplies of storable foodstuffs and raw material and technical questions regarding the kind of war material to be produced, the location of the necessary factories and the organization of reserve productive capacity.

MR. MACMILLAN urges the creation of a single authoritative foreign trade organization which, under the general direction of the Overseas Trade Department, would bring together and combine the activities of the Import Duties Advisory Committee, the experts in charge of the Exchange Equalisation Fund's operations, representatives of finance to advise on foreign lending, and representatives of the exporters' selling organizations and of the importers' buying organizations. He reiterates the plea for a National Economic Council and urges an Industrial Reorganisation (Enabling) Act to afford industry the opportunity of putting its own house in order and achieving the necessary output, and discusses in some detail an attack on the unemployment problem. A Ministry of Supply is regarded as essential, and Mr. Macmillan stresses the compatibility of his proposals with the promotion of social and individual freedom. In his final chapter on nationalism or internationalism, he argues that a policy of static resistance is not enough. If a correct foreign policy sustained by adequate economic and military strength is the first task, this must be followed by the creation of the national foreign trade organization supported by a powerful internal economic organization conducted on rational lines for the full utilization of our capital and labour resources. These measures would enable us to evolve a method of economic collaboration which would eliminate the causes of war.

## Social and Political Implications of Science

CONTINUOUS survey and co-ordination of teaching and research work of the University in the natural and social sciences in terms of its relation to the political and social problems of the day—such was the task undertaken in 1933 by a group of faculty members of the University of Wisconsin. They established an organization known as the "Science Inquiry" which has had the effect of concentrating the attention of much of the University staff on scientific problems facing the State and the nation. A guiding principle has been that attacks upon such problems should be comprehensive rather than departmental so that instead of fragmentary findings "there may emerge at least the beginnings of integrated programmes with improved perspective and balance and with the application of these problems to State needs kept to the front". Among its publications are bulletins on the regional approach to conservation of natural resources, on transportation, and on the fight against crime; also (in preparation) international relations, public utility and power regulations, technological unemployment, communications, and consumption from the points of view of the producer and consumer. It is claimed on behalf of "Science Inquiry" that it has "evolved a group consciousness on the part of the faculty of common human problems which already is having a notable influence on the direction and emphasis of individual activities in teaching as well as research at the University".

## U.S. National Youth Administration

A REPORT prepared for the Advisory Committee on Education of the United States by P. O. Johnson and O. L. Harvey on the National Youth Administration describes the organization and programme of the work of the Administration with a brief evaluation of some of its achievements. The National Youth Administration was set up as an agency within the Works Progress Administration in June 1935 and is thus primarily a relief agency, operating with funds earmarked for the general appropriation by Congress for emergency relief. Its two chief programmes are student aid and work projects, and its detailed operation in the several States varies according to local needs and problems. The number of young persons between 16 and 24 years of age receiving aid on the major programmes rose from about 470,000 a month in the first six months of 1936 to 580,000 a month in the same period of 1937 but has since declined owing to the reduction in the total budget. The student aid programme provides for those youths who are otherwise financially unable to continue their schooling. The works projects programme provides work experience for those whose interest in further schooling is relatively weak but who require work experience as a qualification for admission to private employment and earning a living. The guidance and placement service gives vocational guidance and attempts to place unemployed youth in employment. The apprentice-training programme was only an incidental function of the National Youth Administration and has recently been transferred to the Department of Labour. The programme of educational camps for unemployed women proved expensive to maintain and has been terminated for this and other reasons. The experiments have directed attention to many inadequacies in the provision for vocational guidance and, apart from the prevention of demoralization or restoration of morale, the National Youth Administration has demonstrated the possibilities of concerted action in the solution of the problems of youth, and particularly the value of proper direction and wise planning.

## Recent Developments in British Surveying Instruments

BRIGADIER M. N. MACLEOD delivered the Thomas Young Oration of the Physical Society on March 24, taking as his subject "Some Recent Developments in British Surveying Instruments". Referring to the aerial camera as a surveying instrument, he pointed out that all parts of the ground must be photographed from two separate points. Plotting is done by combining, stereoscopically or otherwise, two such pictures. Plotting from tilted photographs requires complicated apparatus. In the first plotting machines the air positions of the camera and the direction of its optical axis had to be determined by a "resection in space" from control points on each photograph. There are theoretical as well as practical objections, however, to such independent determinations. In 1926, Dr. Fourcade propounded the idea of first determining the *relative* positions of the air cameras without reference to ground points, and devised a stereo-goniometer for this purpose. This principle has been made the basis of a new British automatic plotting machine constructed for the War Office and about to be delivered to the Ordnance Survey. In the majority of automatic plotters, the photographic picture is reconstructed stereoscopically and the image of a mark in the stereoscope is superimposed optically on the view. The visual or 'floating' mark can be moved about by the plotting mechanism and can be made to coincide in depth as well as in alignment with any point in the view. The apparent movements of the mark are transmitted mechanically to a plotting pencil. In all automatic plotters, however, much time is taken in the preliminary adjustment for reconstructing the stereoscopic view and determining its scale and orientation. It is hoped that the new instrument will enable this preliminary setting to be done decidedly more quickly than is the case in any existing foreign model.

## Prehistoric Fire-Dog

COLONEL J. C. WYNNE FINCH, a governor of the National Museum of Wales, has lent to the Museum for purposes of exhibition for a period of two years the remarkable example of Celtic iron-work known as the Capel Garmon fire-dog, which was found at Carreg Caedog Farm, near Capel Garmon, in 1852 by a labourer when digging a drainage trench. It is described (*The Times*, March 16) as constructed of two vertical bars, bent over at the top to form a neck, on to which is fastened a crest and the schematized head of an ox. The bars stand on semi-circular arched feet, and are connected by a horizontal bar thickened towards the middle, presumably to support the weight of the logs. The uprights are ornamented on each side by a ribbon of iron, bent in semi-circular loops, and with spiral coils at the top and bottom. The ribbon between the loops is attached to the upright by heavy decorative rivets. Other finds of a generally similar character have been made in south-eastern England in tombs belonging to the Belgic culture of the Iron Age, to be dated *circa* 100 B.C.–A.D. 50, while others, again approximately of the same period, have been found on the Continent in areas occupied by the Celts, who seem in this instance to have adapted an object of Mediterranean type to their own uses. It is pointed out that the Mediterranean influence may perhaps be seen in a very special fashion in the crest of the Capel Garmon fire-dog, which with its thin vertical strip pierced at intervals with circular holes and bearing a thick bar flattened and curled at its lower end, and in its row of knobs representing the plume socket, suggests a Greek helmet crest. None of the fire-dogs so far discovered is as elaborate as the Capel Garmon specimen, as they lack the crest, the loops on the uprights, and the rivet-heads. The discovery of pairs of fire-dogs together suggests, although it is not known with certainty, that two formed a set, one being placed on each side of the fire, which was laid in the centre of the house.

## New Egyptian Royal Tomb at Tanis

FURTHER details of the Egyptian royal tomb recently discovered at Tanis in the Nile Delta (see NATURE, March 25, p. 512) suggest that the results of its examination may prove of even greater interest than was anticipated at first. Another chamber has now been discovered and opened. It also proved to be intact. It is thought that the explorers may be fortunate enough to find still other chambers which have not been plundered; while there is the even more stimulating possibility that this may be the first only of a whole series of royal burials belonging to the twenty-first and twenty-second dynasties. Again, the walls both of the chamber in which the royal sarcophagus has been found and of that since opened are covered with paintings and inscriptions, from which presumably many historical data will be recovered, such as were, strikingly, absent from the tomb of Tutankhamen. Among those in the chamber of the sarcophagus is the cartouche of King Psusenes, identified with the King Shishak, who plundered Jerusalem in the reign of Rehoboam in 930 B.C. Many finely sculptured jars, some with beautifully carved stoppers, much jewellery of gold and precious stones and a huge sculptured human foot have been found. Within the silver mummy case of King Shishak was an inner casing of gold and leather. The first pictures of the tomb, funerary chambers and finds to reach England appeared in *The Times* of March 27.

## Archæological Expeditions to the East

THE departure for the East of two archæological expeditions is announced, one proceeding to Iran and Afghanistan, and the other to Aden. Of these the former, conducted by Mr. Arthur Upham Pope, an authority on Sassanian art and archæology, is the first section of a new architectural survey expedition of the American Institute of Iranian Art and Archæology, of which Mr. Pope was one of the founders and the principal promoter. The members of the expedition will be engaged in studies preparatory to a complete history of Iranian architecture, a much-needed undertaking which, when complete, will contribute materially to the advancement of Iranian

cultural and historical studies. On the second expedition, Mr. L. P. Kirwan, a well-known archæologist, will visit the Aden Protectorate for the purpose of inspecting and examining a number of archæological sites between Aden and Lahej. He will visit Amadiya on the Audhali Plateau, which will be surveyed, and the ruins of Qohlan in Wadi Beihan. Mr. Kirwan will also examine and report on the archæological material in the Aden Museum, which is now in process of being reorganized.

### Exhibition of Chinese Art

An exhibition has been arranged in the North Court of the Victoria and Albert Museum, South Kensington, which illustrates comprehensively the whole range of Chinese art from the prehistoric period at about 3000 B.C. down to modern times. With the exception of a small series to be seen in the Department of Ceramics, this exhibition includes all the objects of Chinese art of all kinds now in the possession of the Museum. It includes the Museum's share of the Eumorfopoulos collection, which provides some of the most striking and widely known exhibits. The arrangement of the exhibition is chronological and cultural. Each exhibit is grouped with others, whatever their character or material, whether of jade, textile, painting or pottery, provided they belong to the same period and are of the same cultural origin. The first and earliest exhibit is a neolithic pot of about 3000 B.C. A special feature of the exhibition is the important collection of ritual bronzes, which has been provided with special case-labels incorporating small photographs, illustrating the main features of style. A collection of Buddhist sculpture of the fifth and sixth century A.D. is on loan from Baron von der Heydt. Especially noteworthy are two wooden sculptures, one a figure of Kuan Yin, Goddess of Mercy, dating from the twelfth century, and a statue of a seated man, belonging to the fifteenth century. The exhibition is to be permanently on view.

### British Museum (Bloomsbury): Recent Acquisitions

Accessions to the collections of antiquities and ethnographical objects in the British Museum (Bloomsbury) of exceptional interest were reported at the meeting of the Trustees on March 11. Of these one is a remarkably fine example of the Irish twisted gold torque, which has been accepted on loan for temporary exhibition from the Duke of Westminster. It is made from a single bar of gold, 50 inches long and weighing 26 oz. It has been chiselled and beaten into four flanges and then twisted and bent into a circle. The ends are recurved to fit into one another to form a fastening. It is of a type characteristic of the Middle Bronze Age and dates from about 1200 B.C. It was found in 1816 at Bryn Sion Farm, Flintshire. Another accession to the Department of British Antiquities is a collection of fragments of pots of dark earthenware, freely ornamented towards the top with hatchings, pitting, and finger-nail marks, presented by Mr. J. P. T. Burchell. They were excavated by him in the Ebbsfleet Valley, Kent, at a depth of 10 ft. in stratigraphical conditions, which make it certain that this pottery is older than the neolithic period as at present understood. It is possible that this may prove to be the oldest pottery as yet found in Britain. It would seem to be connected with mesolithic types found on the Continent, such as those from the Danish kitchen-middens. It differs from British 'Neolithic A', and may indeed prove to be a predecessor of 'Peterborough' ware. Another accession of considerable archæological interest is a human face, almost circular in outline, carved on a piece of Bath stone found near Charterhouse-on-Mendip. It has almond-shaped eyes and a small round hole for a mouth. It dates from the period of Roman occupation; but is thought to represent a native barbaric tradition. Of the ethnographical accessions the most striking is a wooden totemic figure of an eagle made by the Siwash Indians of Vancouver Island. It stands about four feet high, with wings half-spread, and is painted in gaudy colours, and has a fierce human face painted on the breast.

### British Museum (Natural History): Recent Acquisitions

The Mineral Department of the British Museum (Natural History) has acquired through Mr. Arthur Russell a small collection of foreign minerals from the collection of Philip Rashleigh, F.R.S., of Menabilly, near Fowey, Cornwall (1729–1811). The main part of the Rashleigh Collection is in the Truro Museum. Mr. Arthur Champion has collected rocks from various localities on a remarkable motor journey he made in 1937 from Dakar to Nairobi. The collection includes specimens from French West Africa and the Belgian Congo as well as from Senegal, Gold Coast and Nigeria. A fine specimen of the mineral thortveitite has been received from Prof. T. Vogt of Trondhjem, Norway, and suitable specimens have been sent him in exchange.

### Broadcasting in 1938

The report of the Governors of the British Broadcasting Corporation for the year ended December 31, 1938, as presented to His Majesty's Postmaster-General, has recently been published as a white paper (Cmd. 5951. London: H.M. Stationery Office. 6*d*. net). The scope of the report is indicated by the headings of the main sections into which it is divided, namely, programmes, public relations, engineering and administration. During the year under review, the Corporation suffered a loss by the resignations of its first director-general, Sir John Reith, and of the deputy director-general, Vice-Admiral Sir Charles Carpendale. Mr. F. W. Ogilvie was appointed to the first position, while Mr. C. G. Graves became the new deputy director-general. The staff of the B.B.C. is now more than four thousand, and these have provided to nearly nine million licensed listeners a home broadcasting service of some 79,500 hours in 1938, with the remarkably small breakdown time of 0·023 per cent. In addition, nearly 33,000 hours

of Empire programmes were provided, while the aggregate time of operation for the television sound and vision transmitters has increased from 1,619 hours in 1937 to 2,679 hours in 1938. Among the increased programme facilities provided during the past year were daily news services in Arabic for listeners in the Near and Middle East, and in Spanish and Portuguese for listeners in Latin-American countries. Towards the end of the year, also, daily news services, intended primarily for European reception, were broadcast in French, German and Italian.

On the engineering side, a new medium wave transmitting station was opened at Aberdeen in September; and the construction of a new high-power transmitting station at Start Point in South Devon, and of a medium-power station at Clevedon, Somerset, is proceeding satisfactorily. The number of transmitters normally in use at the Daventry short-wave station has been increased from four to six, so that larger areas may be covered for longer periods. Further expansion is in hand at this station, including the provision of new transmitters and aerial systems. The scope of the television programmes has been considerably extended during 1938 by the provision of increased studio facilities at Alexandra Palace, by the purchase of a second mobile television unit for outside broadcasts, and by the establishment of improved relay link arrangements for such broadcasts. The report concludes with a statement of the financial position as at December 31, 1938.

## Antarctic Whaling

The *Polar Record* for January, a journal which has now widened its scope to include various articles in addition to news of polar expeditions, contains some details of the International Whaling Agreement of 1938. The measures agreed on in 1937 included a minimum size limit for various species, the restriction of the Antarctic whaling season from December 8 to March 7 and the prohibition of pelagic whaling in temperate and tropical waters. Last year the conference went further, though it was decided that restrictions on the numbers of whale catchers were impracticable at present. It was, however, agreed to prohibit the killing of humpback whales in waters south of lat. 40° S. for one year. This species is more vulnerable than blue and fin whales, and it is hoped thus to save the stock from exhaustion. It was also decided to prohibit all pelagic whaling for at least two years in the Pacific waters south of lat. 40° S. between long. 70° W. and 100° W. These waters so far have no pelagic or other whalers and so may well serve as a sanctuary for hunted species. In spite of these restrictions, it is admitted that the industry as a whole is probably taking an unduly large number of whales.

## Australian Cancer Research

The present position of organizations combating cancer in the Antipodes can be seen from the report of the ninth Australian Cancer Conference held in Sydney during April 5–8, 1938 (Canberra: Government Printer, 1938). In many centres of the Commonwealth, new radiological plant has been installed and old apparatus improved, and attempts are being made to improve facilities for diagnosis in country districts. In an address given on the occasion of the Conference, Prof. E. C. Dodds pleaded for development of general research in basic sciences as being probably the best way of helping existing lines of cancer research. Dr. Robert Fowler discussed the research value of clinical records with particular reference to the 'follow-up' of cancer patients, and considered in some detail the indexing of cases. In a population of six and a half millions in Australia there were more than 7,500 deaths from cancer during 1936. A statistical examination of this cancer mortality was made by Dr. M. T. Holmes, who also summarized the results of treatment with radium at Australian centres over a nine-year period. Of 35,000 cases treated with radium, less than 10 per cent showed no improvement. Examination of data along similar lines should indicate how methods of treatment develop and how they compare with those of other countries.

## The Dutch Physical and Medical Congress

The twenty-seventh Dutch Physical and Medical Congress will be held at Nijmegen during April 11–13, 1939, under the presidency of Dr. G. Holst. General lectures will be given by Dr. G. Holst on "The Properties of Magnetic Materials" and by Prof. B. Brouwer on "The Significance of the Hydrodynamic Relations within the Skull Cavity and the Semicircular Canal for Neural Surgery" on April 11, and by Prof. L. S. Ornstein on "Physics and Biology" and by Prof. E. Gorter on "Very Thin Films" on April 12. The scientific work of the meeting will be dealt with in the four sections: Mathematical and Physical Sciences, Biological Sciences, Medical Sciences, Geological-Geographical Sciences, some seventy papers having been promised. A full programme of social functions, visits to factories, laboratories, hospitals and other places of interest has been arranged. Information can be obtained from the "Natuuren Geneeskundig Congresbureau", Bureau Vreemdelingenverkeer, Keizer Karelplein 9, Nijmegen, Holland.

## Kathleen Schlesinger Research Fellowship

The Medical Research Council invite applications for the Kathleen Schlesinger research fellowship which has been provided from a fund established by the late Mr. Eugen M. Schlesinger and Mrs. Schlesinger in memory of their daughter. It will be awarded to a suitably qualified person who will devote his or her whole time to "investigating the origin and nature of cysts of the brain whether arising from tumours or not or to such studies of other conditions of the central nervous system as the Council may from time to time permit". It will ordinarily be tenable at the National Hospital for Diseases of the Nervous System, Queen Square, London, and for a period of one year in the first instance. The stipend will be at the rate of £300 per

annum, with up to £50 per annum for research expenses. Further information can be obtained from the Secretary, Medical Research Council, 38 Old Queen Street, Westminster, S.W.1.

### Earthquakes in Japan and Greece

AN earthquake, reported as the strongest for five years, shook several parts of the island of Kyushu at 12.22 p.m. local time on March 20 (3.22 G.M.T.). The shock was felt in Fukuoka but appears to have been strongest in Miyasaki where property and power lines were damaged and twenty people injured. The nearest active epicentre to this region appears to be 31·8° N., 131·8° E. where shocks occurred on 1929 5 m. 21 d., and 6 m. 11 d. There are three lines of weakness near the island of Kyushu according to Imamura: two pass through Nagasaki and run roughly east-north-east and south-south-east whilst the other is just off, and approximately parallel to, the south-east coast.

AN earthquake shock of considerable intensity was felt on March 27 in Athens and other Greek towns though no great damage is reported. The epicentre of the shock was probably near Chalcis though very little information is at present available. It will be remembered that the centre of the disturbances on July 20, 1938, was near 38·35° N., 23·8° E., near Scala Oropos.

### Royal Geographical Society: Awards

HIS MAJESTY THE KING has approved the award of the Royal Medals of the Royal Geographical Society as follows: The Founder's Medal to Mr. Arthur Mortimer Champion, for his surveys of the Turkana Province and the volcanoes south of Lake Rudolf; the Patron's Medal to Prof. Hans Ahlmann of Stockholm, for his exploration and glaciological studies in the Arctic. The Council has awarded the Murchison Grant to Mr. Robert Bentham, for his mapping and geological investigations in Ellesmere Land; the Back Grant to Lieut.-Commander R. E. D. Ryder, for his captaincy of the *Penola* and his marine surveys on the British Graham Land Expedition; the Cuthbert Peek Grant to Mr. W. Vaughan Lewis, for his physiographical studies in Great Britain and Iceland; the Gill Memorial to Mr. J. V. Harrison, for many years' exploration in Central and South America and Southern Iran.

### Announcements

COLONEL J. A. MANIFOLD has been appointed director of hygiene at the War Office in succession to Major-General H. H. A. Emerson, who will retire shortly.

THE Herbert Jackson Prize for 1938 of the L.M.S. Railway Co. has been awarded to Mr. J. N. Bradley, an assistant metallurgist in the Company's Research Laboratory at Derby, for his paper entitled "The Separation of Mixed Gunmetal and White Metal Borings". A Jackson Medal has also been awarded to Mr. C. W. Newberry, research assistant in the engineering section of the same Laboratory, for a paper entitled "An Investigation into the Occurrence and Causes of Locomotive Tyre Failures". The Herbert Jackson Prize is awarded annually by the L.M.S. in memory of the late Sir Herbert Jackson (an original member of the L.M.S. Advisory Committee on Scientific Research), to a member of the Company's research staff for the best written account of an investigation carried out in the Companies' Laboratories during the year.

AT the annual general meeting of the Ray Society held on March 23, the following officers were re-elected: *President*, Sir Sidney F. Harmer; *Treasurer*, Prof. F. E. Weiss; *Secretary*, Dr. W. T. Calman. Dr. John Ramsbottom was elected a vice-president, and Mr. E. R. Martin, Mr. D. M. Reid, and Col. R. B. Seymour Sewell were elected new members of Council. It was announced that a "Bibliography of the larvæ of Decapod Crustacea" by Dr. R. Gurney, and the first of two volumes on "The Comity of Spiders" by Dr. W. S. Bristowe are in the press and will be published shortly. The first volume of a work on "British Water Beetles" by Prof. F. Balfour-Browne is nearly completed and will form the issue to subscribers for 1939.

THE University of Pavia has arranged a celebration in honour of the eighteenth-century physiologist, biologist and vulcanologist, Spallanzani (1729–1799), which is to be held in Pavia on April 11–14. A monument to Spallanzani is to be unveiled and a programme of scientific addresses, mainly on modern genetical problems and the physiology of reproduction, is being prepared by delegates invited from various countries, including Prof. R. Ruggles Gates, Prof. F. A. E. Crew and Dr. C. F. Pantin from Great Britain. Meetings of the societies for experimental biology, botany, geology and veterinary medicine are also being held at the University, and on April 15 a visit will be paid to the Spallanzani Museum at Reggio Emilia.

IN 1937 the birth-rate in the U.S.S.R. was 18–19 per cent higher than in 1936 and the increase in population was a little more than 2 per cent. During the first ten months of 1938 there were 100,000 more marriages in the Soviet Union than in the corresponding period of 1937.

PROF. V. A. FOCK, of the University of Leningrad, writes that the transcription of his name in the article on the U.S.S.R. Academy of Sciences in NATURE of February 25, p. 343, namely, Fok, is incorrect and should be as here indicated.

ERRATUM. In the list of "Forthcoming Books of Science" in NATURE of March 11, p. 428, the volume by Prof. E. J. Conway to be published by Messrs. Crosby Lockwood and Son, Ltd., should be entitled "Microdiffusion Analysis and Volumetric Error".

# Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 564.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Activity of the Succinic Dehydrogenase

IT has long been held that the succinic dehydrogenase requires no co-enzyme or intermediary hydrogen carrier to link its activity with that of the cytochrome system.

Ahlgren[1], however, working with a preparation made by extracting washed horse muscle with a solution of disodium hydrogen phosphate, found that with added succinic acid it induced an oxygen uptake which, though vigorous at first, rapidly fell to near zero. In the presence, however, of a *Kochsaft* from rabbit-muscle, the uptake was greater and much longer sustained, indicating that a thermostable factor may be necessary to complete the activity of the enzyme. He found, on the other hand, that the presence of the *Kochsaft* had no effect whatever on the rate at which the enzyme preparation reduced methylene blue.

Ahlgren's results have much interest but do not perhaps yield quite definite conclusions. The significance of the effect of muscle-*Kochsaft* as observed by him seems to be lessened by the experimental results we have to report.

We have ourselves obtained, from pigs' heart muscles and rabbits' skeletal muscles, preparations of the succinic enzyme which, in the presence of the substrate, actively reduce methylene blue anaerobically, but prove quite unable to induce any oxygen uptake, though in a system containing adequate concentrations of cytochrome *c* and its oxidase. In what follows, the method by which such preparations have been obtained will be briefly described, together with some details of their behaviour.

In an attempt to purify or concentrate the enzyme we have tried the solvent power of ethylene glycoll, dodecyl sulphate, formamide, saponins and bile acids, and also glycerol and phenol. With the exception of bile salts, none of these was satisfactory. In our final procedure we have started with the muscle residue left after thorough extraction with sodium and lithium chlorides (Hopkins, Morgan and Mann)[2]. This is first extracted with a solution of bile salts. In most experiments a commercial preparation of tauroglycocholate in 10 per cent solution was employed, but we have later used pure sodium desoxycholate (4 per cent) with advantage. The material insoluble in such solutions, being centrifuged off, the supernatant solution is clear, or shows at most a slight opalescence. It is cooled to 0° C., and mixed with an equal volume of ice-cold ethyl alcohol. The resulting precipitate is centrifuged off and washed with cold alcohol until free from bile salts. The alcohol precipitate is then extracted with 20 per cent urea solution. Finally, the urea is removed by dialysis and the precipitate, which rapidly separates, constitutes the preparation used in our experiments. It is insoluble in water, and we have employed it in the form of a milky aqueous suspension.

It is easy to show that a factor not involved in the activation of the succinic acid hydrogen atoms, but essential for their transfer to the cytochrome system, is, at the stage of extraction with bile salts, dissociated from the enzyme and is itself not soluble in bile salt solutions. That the hydrogen activation is independent of such a factor is made sure by the consistently high activity of these solutions as displayed by the Thunberg technique, in spite of the fact, which separate experiments have shown, that bile salts somewhat inhibit (reversibly) the enzyme activity. The failure of hydrogen transference can be shown spectroscopically or manometrically. The chloride extracted muscle reduces cytochrome freely, but if to the bile solution (with substrate) oxidized cytochrome be added, there is no reduction at all, or, at most, a very slow and feeble one. It is easy to show that the cytochrome oxidase is present in these bile extracts.

Manometric results demonstrate unequivocally that, in a system containing succinates, cytochrome and its oxidase, the bile salt solution induces no oxygen uptake. This is equally true of our final preparation in spite of its high activity with the methylene blue technique.

The addition of methylene blue (1 mgm. in 3 c.c. of solution) to a system containing the purified product results in an oxygen uptake which, though relatively slow in the bile solution, is rapid in the final preparation. None of the known coenzymes can act as the missing carrier of hydrogen, nor can glutathione, vitamin $B_1$, adrenaline, ascorbic acid, nicotinic acid amide. With flavin-adenine dinucleotide a slight but probably not a significant uptake of oxygen may be observed. A muscle-*Kochsaft* similar to that used by Ahlgren has even less effect. If very high concentrations of cytochrome *c* are added to the bile solution there is a slow oxygen uptake. With the final preparation this is not observed.

It is of some interest to compare the contents of the original bile extract with those of the final product. In the former, in addition to the succinic dehydrogenase, the lactic dehydrogenase is present, but not the glycerophosphate enzyme which contact with bile salts destroys. Cytochrome oxidase and cytochromes *a*, *b*, *c* are present, though the spectra *a* and *b* are weak. Diaphorase (flavoprotein) is present. In the final preparation the lactic enzyme is not found, nor is the cytochrome oxidase. It contains some cytochrome *c*, but the spectra of *a* and *b* are not visible. Diaphorase is still present.

The striking difference between the glycerophosphate and the succinic enzymes is noteworthy, the latter being completely resistant to the action of

the bile salts. On the other hand, the lactic enzyme, while resistant to bile salts, is wholly destroyed by urea. This recalls the equally striking difference between these enzymes under the influence of glutathione (Hopkins and Morgan)[3].

The following table summarizes some typical results of our experiments.

30 mgm. dry weight of enzyme preparation, 0·3 ml. *M*/2 succinate, *p*H = 7·6, temperature 37°.

| Methylene blue (400 γ) | Reduction in minutes | Oxygen uptake (μl/30 min.) | |
|---|---|---|---|
| 1. Salt extr. heart muscle .. .. | 5 | 1. Salt extr. heart muscle .. .. | 220 |
| 2. Salt extr. heart muscle in presence of desoxycholate | 12 | 2. Salt extr. heart muscle in presence of desoxycholate | 170 |
| 3. Bile extract .. | 6 | 3. Bile extract alone | 9 |
| 4. Final preparation | 5 | 4. „ „ + 1 mgm. MB | 100 |
| | | 5. „ „ + 0·2 c.c. *Kochsalt* .. | 15 |
| | | 6. Final preparation alone .. | 0 |
| | | 7. „ preparation + 1 mgm. MB | 180 |

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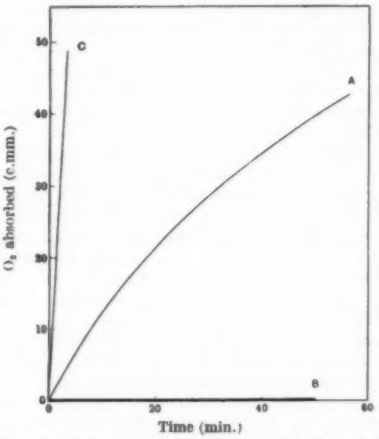
[1] Ahlgren, G., *Skand. Arch. Phys.*, **80**, 16 (1938).
[2] Hopkins, F. G., Morgan, E. J., and Lutwak-Mann, C., *Biochem. J.*, **32**, 1829 (1938).
[3] Hopkins, F. G., and Morgan, E. J., *Biochem. J.*, **32**, 611 (1938).

## Lactic Dehydrogenase and Cytochrome

THE bulk of the respiration of most animal tissues, yeast, etc., takes place through the alternate oxidation and reduction of cytochrome. The reduction of cytochrome is mainly due (*a*) to a small group of dehydrogenases which are believed to reduce cytochrome directly, and (*b*) to flavoproteins which transport hydrogen from other dehydrogenases through coenzymes I and II. A typical dehydrogenase of the first class is the lactic dehydrogenase of yeast, which does not depend upon these coenzymes or flavoprotein, but which in the crude state reduces cytochrome *c* readily in the presence of lactate. Some months ago we observed that a partially purified preparation of this dehydrogenase failed to reduce cytochrome, though it still reduced other hydrogen acceptors like methylene blue. We are at present engaged in the purification and isolation of this enzyme. We find that the purified enzyme still reduces methylene blue freely in the presence of lactate, but is completely inactive towards cytochrome. The following experiment shows this very clearly.

Absorption of oxygen was measured in Barcroft manometers in the usual way. Curve *A* shows the oxygen uptake of the purified lactic dehydrogenase + lactate + methylene blue: any methylene blue reduced is, of course, re-oxidized with uptake of oxygen. Curve *B* shows the uptake of the dehydrogenase + lactate + cytochrome *c* + cytochrome oxidase: had any cytochrome been reduced it would have been re-oxidized by the oxidase with uptake of oxygen. Curve *C* shows the uptake of *p*-phenylenediamine + cytochrome + cytochrome oxidase, showing the presence of an excess of oxidase, which was highly active in oxidizing cytochrome reduced by the *p*-phenylenediamine.

These results show that an additional catalyst is necessary for the reduction of cytochrome, possibly a hydrogen-carrier acting between the dehydrogenase and cytochrome. This is present in the crude preparations, but is removed in the purification process. We have shown that this catalyst is not identical with any of the known coenzymes, the flavoproteins of yeast or muscle, or the flavine mono- or di-nucleotides. It is of interest that Haas[1] finds that although




CURVE *A*: 1 C.C. LACTIC DEHYDROGENASE + 0·3 C.C. *M*. LACTATE + 0·1 C.C. *M*/1,000 METHYLENE BLUE + 1·6 C.C. BUFFER.
CURVE *B*: 1 C.C. LACTIC DEHYDROGENASE + 0·3 C.C. LACTATE + 0·5 C.C. CYTOCHROME *c* + 1 C.C. CYTOCHROME OXIDASE + 0·2 C.C. BUFFER.
CURVE *C*: 0·2 C.C. *p*-PHENYLENEDIAMINE + 0·5 C.C. CYTOCHROME *c* + 1 C.C. CYTOCHROME OXIDASE + 1·3 C.C. BUFFER.

his flavoprotein reduces cytochrome, it loses this property when highly purified. It is possible that the same or a similar catalyst is involved. If this catalyst is necessary for the reduction of cytochrome, it follows that it must play a very important part in cell respiration.

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[1] Haas, *Biochem. Z.*, **298**, 378 (1938).

## A New Method of the Determination of Saturation by Vitamin C

THE only reliable method for determination of the saturation of the living body by vitamin C has so far been that of Tillmann-Harris-Ray. It consists essentially of the daily administration of 300 mgm. of ascorbic acid intravenously, until at least half of this amount reappears in the urine. If the body was saturated, the ejection of this quantity takes place within 1–4 days afterwards. If hypovitaminosis dominates, then the ejection is delayed. So far, by examining blood directly only extreme values can be evaluated: above 1 mgm. per cent indicates saturation, while below 0·4 mgm. per cent indicates hypovitaminosis. Concentrations ranging between cannot be evaluated properly, because

0·5 mgm. per cent may already signify saturation, while in contradistinction 0·9 mgm. per cent may, in certain circumstances, indicate hypovitaminosis.

It seemed probable that intravenous injection of 300 mgm. of ascorbic acid after a previous determination of the vitamin C concentration prevailing in blood may disclose, after repeated determination, whether saturation or hypovitaminosis was originally present. In the latter case, the amount of vitamin injected may be expected to make up the amount and the subsequent determination would disclose this fact by giving the same or an only slightly increased value compared with that of the first determination. If, on the other hand, saturation originally prevailed, the values of the second determination would disclose an increased amount, the organs storing the substance either slowly or not at all.

The validity of this assumption was proved experimentally. If the first determination disclosed less than 1 mgm. per cent concentration, and 300 mgm. were injected, at least double the amount was determined two hours afterwards, indicating that originally saturation dominated. If hypovitaminosis was originally prevalent, the ultimately determined amount was the same as the original, or slightly increased, but never twice as much.

In cases which displayed a concentration higher than 1 mgm. per cent from the start, this was not always doubled after the subsequent injection, the surplus being somehow ejected. In some cases it was possible to ascertain that the ejection was due to the renal function. The practicability of the test is not impaired by this since concentration above 1 mgm. per cent signifies saturation anyhow. All cases were controlled by the Tillmann-Harris-Ray test and the intracutaneous method of Rotter.

For determining the blood concentration, the method of Berend-Fischer was applied, this being sufficiently simple for clinical purposes. Out of forty cases investigated, only one proved a failure.

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## Free and Bound Vitamin $B_1$ in Milk

WE have shown[1] that the fluorimetric assay[2] of vitamin $B_1$ in milk gives values about 50 per cent lower than the biological test. The difference was not due to the presence in milk of free cocarboxylase or of the monophosphate, as in no case could more than a trace of fluorescence due to oxidized phosphorylated aneurin be observed in the aqueous layer after extraction with iso-butanol.

We now find that after incubation of raw milk or of reconstituted dried milk with taka-diastase (containing taka-phosphatase, protease and doubtless other enzymes) at *p*H 3·7–4·0, the fluorimetric assay is almost doubled. Peptic digestion gives very similar results even when the phosphatases of milk have been inactivated by heating.

It seems probable, therefore, that, in addition to free vitamin $B_1$ there is present in milk a vitamin $B_1$-protein complex. Ultra-filtration experiments support this view. After filtration of milk through 'Cellophane'[3] the serum contains only free aneurin and the substance which yields vitamin $B_1$ after incubation with pepsin or treatment with taka-diastase is concentrated in the protein fraction. The recovery is nearly quantitative.

The evidence suggests that the bound vitamin $B_1$ is not adsorbed but is a constituent of the protein molecule.

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Feb. 28.

[1] Henry, Houston and Kon, *Chem. and Ind.*, **57**, 974 (1938).
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## Production of Diacetyl by Fæcal Streptococci

IN an investigation of the metabolism of both 'resting' and growing cells of lactic acid bacteria we have found that only the fæcal streptococci (*Str. fæcalis* and *Str. liquefaciens*) produce considerable quantities of diacetyl, which is recognized to be responsible for part of the aroma of milk products. No other lactic acid bacterium studied in this way produced diacetyl.

The bacteria in massive suspension were held in phosphate buffer plus glucose at *p*H 6·25, or grown in milk and yeast milk. Diacetyl was only produced in the presence of oxygen. Distillation with ferric chloride greatly increased the yield of diacetyl so that of the acetoin produced in the fermentation only a small part had been oxidized to diacetyl, which was identified by smell, the Vosges-Proskauer reaction and the formation of nickel dimethylglyoxime.

Aroma in butter and other milk products is usually attributed to the fermentation of citric acid by the citric fermenting streptococci[1] and it has also been claimed that the heterofermentative lactobacilli can produce the aroma substances[2]. It may be emphasized that both these groups are quite unable to form the aroma compounds from glucose under 'metabolic' conditions.

PRODUCTION OF AROMA CONSTITUENTS UNDER AEROBIC CONDITIONS.

| | "Metabolic" tests (Washed cells in glucose-phosphate) | | Cultural tests (Growing bacteria in milk and yeast milk) | |
|---|---|---|---|---|
| | *Str. fæcalis* | Heterofermentative streptococci and lactobacilli | *Str. fæcalis* | Heterofermentative streptococci and lactobacilli |
| Volatile acid | + | + | 0 | + |
| Alcohol | 0 | 0 | 0 | + |
| Diacetyl + acetoin | + | 0 | + | 0 |

It is well recognized that milk produced in a very clean manner yields a mild flavoured cheese and that the best and fullest flavoured cheese are frequently made under conditions favouring the seeding of the milk with many organisms, of which the fæcal streptococci may be directly concerned in the production of flavour.

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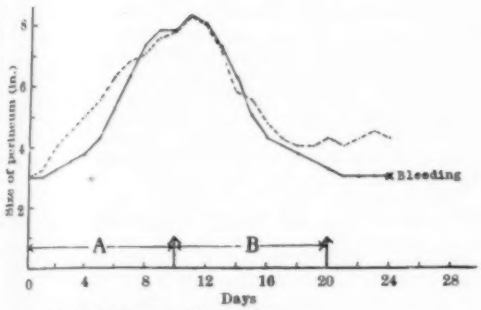
Feb. 22.

[1] Hammerl, *Res. Bull. Ia. Agr. Exp. Sta.*, **63** (1920).
[2] Ritter, *Landw. Jahrb. Schweiz.*, 218 (1934).

## Quantitative Inhibition of Œstrone by Progesterone in the Baboon, with Reference to this Phenomenon in other Animals

THE object of this preliminary note is to direct attention to the remarkable variation existing in different species of mammals in their sensitivity to the action of the ovarian hormones.

Experiments have been performed on the prepubertal baboon (*Papio porcarius*) and the size of the perineum has been used as an indicator of activity since the variations of the perineal swelling during the menstrual cycle have been shown to be as useful an indicator as the vaginal smear method[1].




*A*, 10 daily injections of œstradiol;
*B*, 11 daily injections of œstradiol and progesterone.

GRAPHS ILLUSTRATING THE DIFFERENT EFFECTS PRODUCED BY 1 MGM. AND 2 MGM. PROGESTERONE GIVEN SIMULTANEOUSLY WITH ŒSTRADIOL IN THE SAME IMMATURE BABOON.

- - - - 1 mgm. œstradiol benzoate injected daily for 10 days, followed by the simultaneous injection of 1 mgm. œstradiol benzoate and 1 mgm. progesterone daily for 11 days. Note the incomplete deturgescence and absence of bleeding within 96 hours.

——— 1 mgm. œstradiol benzoate injected daily for 10 days, followed by the simultaneous injection of 1 mgm. œstradiol benzoate and 2 mgm. progesterone daily for 11 days. Note complete deturgescence and bleeding within 96 hours.

Prepubertal baboons were first given 1 mgm. œstradiol benzoate for 10 days to produce perineal turgescence and then given simultaneous daily doses of 1 mgm. œstradiol benzoate together with varying amounts of progesterone. When 3 and 2 mgm. progesterone are administered under these conditions the induced perineal turgescence rapidly disappears and the perineum returns to rest. Bleeding follows within 60–90 hours after the last injection. When, however, only 1 mgm. progesterone is injected together with 1 mgm. œstradiol benzoate, the deturgescence is much slower, and bleeding does not occur within 96 hours after the last injection, as shown in the accompanying graphs. On this basis we conclude that 1 mgm. progesterone is just insufficient to inhibit the action of 1 mgm. œstradiol benzoate on the perineum of the baboon, whereas 2 mgm. progesterone completely inhibits 1 mgm. œstradiol benzoate.

It is important to compare our findings with those of other investigators who used methods similar to our method on other animals which, however, were castrated.

(*a*) Robson[2], in the mouse, found that 750 μgm. progesterone was required to induce an inhibitory effect on 0·2 μgm. œstrone (that is, 3,750 progesterone: 1 œstrone by weight). In the rabbit, however, Robson[3] found that the effect of 0·75 μgm. progesterone could be completely inhibited by 0·01 μgm. œstrone (that is, 75 progesterone : 1 œstrone by weight). These results indicate that the rabbit is fifty times more sensitive to progesterone than the mouse.

(*b*) Leonard, Hisaw and Fevold[4] found that in rabbits castrated during œstrus 10 R.U. œstrone seemed to be the smallest quantity required to prevent the action of 1 Rabbit Unit 'corporin'. In the monkey, on the other hand, Hisaw[5] discovered that ½ Rb.U. 'corporin' is at least partially effective in counteracting 100 R.U. œstrone. These experiments indicate that the monkey is twenty times more sensitive to progesterone than the rabbit.

(*c*) Our own experiments indicate that 2 mgm. progesterone is completely effective in inhibiting the action of 1 mgm. œstradiol benzoate on the perineum of the baboon (that is, 2 progesterone : 1 œstradiol benzoate by weight). Robson[2], using œstradiol in the mouse, found that 750 μgm. progesterone were required to induce an inhibitory effect on 0·05 μgm. œstradiol (that is, 15,000 progesterone : 1 œstradiol by weight). These findings suggest that the baboon is about 7,500 times more sensitive to progesterone than the mouse.

From the above homologies (*a*), (*b*), (*c*), we may express mathematically the sensitivity to the action of progesterone of the various animals discussed as follows:

baboon : monkey : rabbit : mouse : : 7500 : 1000 : 50 : 1.

It is suggested that as we ascend the phylogenetic scale in the animal kingdom there is an increasing sensitivity to the action of progesterone, and it is possible that in the human female an even greater sensitivity to the action of progesterone may exist.

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Jan. 31.

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## Transmutations of Uranium and Thorium Nuclei by Neutrons

WE have recently bombarded layers of uranium oxide and thorium oxide with a mixture of fast and slow neutrons and investigated chemically the active substances obtained on glass plates about 1 mm. away. These active bodies, which result from the bursting of the particular nucleus[1], were dissolved off for analysis with aqua regia, tests showing that no comparable activities came from the glass itself.

In the case of uranium we have been able to assign half-lives of 86 min. to barium, 4 hr. and 40 hr. to lanthanum and 16 min., 75 min. and 72–76 hr. to elements of the 'trans-uranium' type (precipitated

with platinum as carrier from 2*N* hydrochloric acid solution with hydrogen sulphide). We consider the appearance of the 16 min. and 72–76 hr. activities (presumably identical with Hahn, Meitner and Strassmann's[2] 16 min. eka-rhenium and 66 hr. eka-iridium) on the glass plate to be conclusive proof that these substances must be due to recoiling fragments of the bursting uranium nucleus, and that they are not 'trans-uranium' elements coming from uranium by a chain of β-processes.

We have been looking also for possible 'trans-uranium' elements resulting from the decay of uranium (23 min.), which is certainly a uranium isotope. Some weak activities which have some of the properties of 'trans-uranium' elements have been found. More rigorous tests are in progress, however, to make their identity certain.

The activities which are obtained by recoil on the glass plates when thorium is bombarded have also been studied. As a great number of periods were observed, we have for the present classified only some of them into groups according to their chemical behaviour. We found, for example, bodies of 80 min., 14 hr. and 12 days half-lives with the properties of rare earths (lanthanum carrier), 6 hr. with those of barium, 70 min., 4½ days and about 11 hr. (which latter appears to grow from the 4½-day body) with the properties of noble metals. Blank tests showed that thorium B and thorium C activities were negligible.

In addition, from samples of specially purified thorium nitrate irradiated in bulk, activities of 2½ hr. and 22 hr. were extracted which had the properties of bromine. Since the 2½ hr. period has been assigned[3] to $^{83}$Br, it is natural to identify this with our 2½ hr. period. Two weak selenium activities (some hours and some days) were also observed.

These experiments were possible only through the kind collaboration of the High Tension Laboratory staff, who provided the neutron sources (lithium + deuteron). We are also indebted to Dr. R. S. Krishnan for his aid in taking readings with the counter set.

E. BRETSCHER.
L. G. COOK.

Cavendish Laboratory,
Cambridge.
March 11.

[1] Joliot, F., *C.R.*, **208**, 341 (1939).
[2] Hahn, Meitner and Strassmann, *Ber.*, **69**, 905 (1936); **70**, 1374 (1937).
[3] Snell, A. H., *Phys. Rev.*, **52**, 1007 (1937).

## Liquefaction of Helium

ON March 7, we succeeded in liquefying helium by using an apparatus based on the Simon expansion principle. We obtained with one expansion, starting from a pressure of 80 atm. and a temperature of 14·6° K., a quantity of about 65 c.c. of liquid helium. The maximum capacity of our apparatus is about 120 c.c. It was also possible to lower the temperature to 3·3° K., by reducing the pressure above the helium.

We made also one expansion starting from a pressure of 30 atm. and a temperature of 24° K., and we arrived at a temperature of 11° K.

It is worth pointing out that the time which is necessary to obtain liquid helium by this method is relatively short. On March 7 we obtained helium in 6 hours. On March 14 we repeated the experiment, and then only 4 hours was required to obtain liquid helium. It will no doubt be possible to reduce this time to only 3 hours. In this time is also reckoned the time which is necessary to liquefy the hydrogen used for this experiment.

During these experiments I was assisted by M. van Dingenen and M. A. Werner.

A. VAN ITTERBEEK.

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March 15.

## Effect of Foreign Gases on the Continuous Absorption Spectrum of Bromine

ALTHOUGH much attention has been devoted to the broadening of spectral lines in the presence of foreign gases, little systematic work has been done on the effect of foreign gases on intensities of absorption spectra. We have therefore examined the effect of the following gases on the continuous absorption of bromine, using an objective method of photographic photometry: hydrogen chloride and bromide, carbon dioxide, oxygen and nitrogen.

With bromine and the foreign gas at partial pressures of 2 cm. and 60 cm. respectively, the effect is to increase the intensity of the main absorption continuum ($\lambda_{max.}$ = 4150 A.) without altering the general shape of the absorption curve. The *A* and *B* components of this continuum[1] are affected about equally, and there is practically no shift in the position of the maximum. The table of absorption coefficients at the maximum serves to show the magnitude of the effect.

| Gas | Bromine alone | Bromine plus 60 cm. of | | | | |
|---|---|---|---|---|---|---|
| | | HCl | $CO_2$ | HBr | $O_2$ | $N_2$ |
| $\varepsilon_{max.}$ | 152 | 191 | 184 | 182 | 167 | 163 |

Experiments with varying partial pressures of hydrogen chloride and carbon dioxide indicate that the increase in intensity is proportional to the partial pressure of the foreign gas.

The ultra-violet absorption continuum of bromine between 3300 A. and 2500 A.[2] is affected to a much greater extent, the intensity being increased as much as ten-fold by 60 cm. of hydrogen chloride or bromide. In this region, numerical values of the absorption coefficient may have little meaning, since in the presence of oxygen they are not independent of the partial pressure of bromine.

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A. L. G. REES.

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University of Melbourne.
Jan. 27.

[1] Acton, Aickin and Bayliss, *J. Chem. Phys.*, **4**, 474 (1936).
[2] Aickin and Bayliss, *Trans. Far. Soc.*, **34**, 1371 (1938).

## Theory of Mesons and Nuclear Forces

IN a recent note[1] on the static interaction between nuclear particles, Dr. C. Møller and Prof. L. Rosenfeld describe the results of a canonical transformation which makes it possible to separate dynamic and static interactions, and they state: "The static interaction is in all cases exactly the same as that obtained as a first approximation in the perturbation method". They referred to certain work done previously[2] by

me, and I wish to point out that the above statement does not correspond to my results. If this statement applies to the interaction between two Dirac electrons, this is only because in that case we have but *one component* of the field giving static effect, namely, the electrostatic potential. For nuclear interactions, the field must have at least *two components* (usually expressed as one complex field : the meson field). If one tries as before to separate each component into the static solution of the wave equation and the transformed field component, one finds that this transformation is no longer canonical. This is due to the fact that these static parts do not commute because they are formed with the aid of the non-commuting 'isotopic spin matrices' of the heavy particles.

However, canonical transformations exist, which separate a static part of the field (different from the static solution of the wave equation). These transformations introduce a static interaction, which is *not the same* as the one obtained as a first approximation in the perturbation method. Its exact form will be discussed elsewhere, but we can state that, expressed as a power series, its first term corresponds to the first approximation in the perturbation method.

The equations for the transformed fields (pure radiation fields) are, in the static approximation, obviously satisfied by the particular solution : transformed fields equal to zero. (The term "static approximation" means that all effects due to *particle velocity* have been neglected.) However, if these fields are considered as quantum mechanical variables, it is known that their squares can never be zero (zero point energy of the radiation field). This fact leads to an additional, also purely static, displacement of the nuclear energy levels proportional to Planck's constant $h$.

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Feb. 17.

[1] Møller and Rosenfeld, NATURE, **143**, 241 (1939).
[2] Stueckelberg, *C.R.*, **207**, 387 (1938) ; *Phys. Rev.*, **54**, 889 (1938).

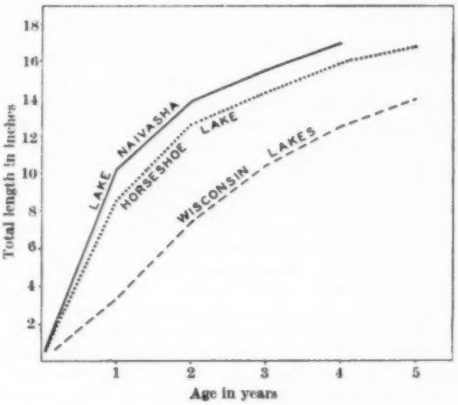
## Growth of the Large-mouth Black Bass, *Huro salmoides*, in Lake Naivasha, Kenya

RECENTLY, measurements and samples of scales from twenty large-mouth black bass caught in Lake Naivasha were received from Dr. Richard H. Le Pelley, of the Scott Agricultural Laboratories, Nairobi, Kenya. The sizes of these fish are about the same as are taken in good bass-fishing lakes in the Mississippi valley. Although the temperature range of Lake Naivasha is very small, the scales of these fish have annual rings much as in bass taken in temperate regions. The ages of these twenty bass have been read as follows :

| Age (years) | Weight | Total length (inches) | Age (years) | Weight | Total length (inches) |
|---|---|---|---|---|---|
| 4 | 2 lb. 8 oz. | 17 | 2 | 2 lb. 6 oz. | 14 |
| 3 | 2 2 | 15 | 2 | 1 14 | 14 |
| 3 | 2 0 | 15 | 2 | 1 6 | 14 |
| 3 | 1 14 | 15 | 2 | 1 8 | 13 |
| 3 | 1 2 | 12 | 2 | 1 4 | 13 |
| 2 | 3 4 | 17 | 2 | 0 12 | 12 |
| 2 | 3 4 | 17 | 1 | 0 8 | 11 |
| 2 | 2 0 | 15 | 1 | 0 7 | 10 |
| 2 | 1 14 | 15 | 1 | 0 8 | 9 |
| 2 | 1 8 | 15 | 1 | 0 7 | 9 |

Excerpts from Dr. Le Pelley's letter give the essential facts about this bass population and Lake Naivasha.

"As far as I can find out, the following information on the introduction of this fish to Kenya is accurate. The young fry were obtained from somewhere in Europe where the introduction [from America] had been made previously. Nearly all died on the journey, but the remainder, about fifty-three young black bass about three inches long, were loosed in Lake Naivasha in February, 1929. They flourished and bred, and fishing began in October, 1931. The fish is plentiful to-day. Previous to 1925 the only fish in the lake was a minnow-like fish *Haplochilus antinorii*. In 1925 *Tilapia nigra* was introduced and this multiplied enormously. Both these species, as well as frogs and other animals, form the food of the bass. The largest black bass recorded, taken from Naivasha in 1937, was 6½ pounds.




"Lake Naivasha lies at an altitude of about 6200 feet ; is about 100 square miles in area ; approximate position 36° E. longitude, 1° S. latitude ; 15 metres deep, temperature 62° F., with probably a very small range only.

"Black bass have also been introduced into one of our rivers—the Athi River, where they appear to be established."

An average growth curve has been computed from measurements of the distances between annuli along the anterior radii of the scales. For comparison, growth curves for large-mouth bass in Horseshoe Lake[1] in southern Illinois, and for the lakes of Wisconsin[2], are included. In the Illinois lake, the first year of growth was unusually rapid, as the result of abundant animal food for young bass and lack of competition with other carnivorous fishes. In the Wisconsin lakes, the growing season for bass is about half that of Horseshoe. These northern lakes have ample food for the larger sizes ; but fingerlings find food scarce and competition with other species keen.

The Naivasha bass averaged 14 per cent heavier than bass of the same lengths from a population which is regarded as normal for Illinois, and the bass of the latter, in turn, are heavier than Wisconsin bass of the same lengths.

In Illinois, most large-mouth bass form their annuli in May and June, and it has been of interest to find out when they form their annuli in a lake so near

the equator with a very small temperature range (Illinois bass tolerate 32° F. to 90+° F.). In no case did the Naivasha scales show an annulus near the edge. The amount of scale-growth outside the last annulus averaged 97 per cent of the corresponding whole year's growth in the scales of older fishes. Since these scales were collected on March 17, it would seem to indicate that annuli would be formed very soon—probably in April. It may be expected that they also spawn at this time, since spawning and annulus formation are known to occur at about the same time.

DAVID H. THOMPSON.

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Jan. 27.

[1] Thompson, David H., and Bennett, G. W., "Lake Management Reports, 1. Horseshoe Lake near Cairo, Illinois", *Biol. Notes, Ill. Nat. Hist. Surv.*, **8**, 1 (1938).

[2] Bennett, G. W., "The Growth of the Large Mouthed Black Bass *Huro salmoides* (Lacépède), in the Waters of Wisconsin", *Copeia*, **2**, 104 (1937).

## Course of Pollen Tube Growth in *Carica papaya* and *Cucurbita* spp.

IN a recent paper, Gustafson[1] states with reference to pumpkin and crookneck summer squash (*Cucurbita* spp.) that the "application of pollen to one side of the ovary did not limit the development of the seeds to that side, and the seed distribution was quite uniform even when as much as five-sixths of the stigma had been removed. . . . It was expected, however, that the seeds might develop only on that side of the ovary where the pollen was applied and the side without seeds would be apertrophied". Work on the course of pollen tube growth in *Carica papaya*, carried on by us in Florida in 1936 as part of a Bankhead-Jones project, has a bearing on this subject. The Caricaceæ are related not distantly to the Cucurbitaceæ, but the former have superior ovaries in contrast to inferior ovaries in the latter. However, the general place of entry of the pollen tubes in relation to the extent and display of the placental surface is similar.

The paraffin embedding method was used in this work, and the pollen tubes were stained with acid fuchsin to which light green was added according to the formula of Buchholz. In *Carica papaya*, the pollen tubes grow from the stigma through the central region of the style to the apical end of the ovarian cavity, and then emerge into, and grow on, the surface of the ovarian cavity to the ovules. The ovarian cavity is relatively large (approximately 18 mm. long in the material used), and under the conditions of the experiment it took about five days for the pollen tubes to reach the ovules at the proximal end, although the ovules at the apical end were reached in about one and a half days. Since the tubes enter the ovarian cavity directly at the centre at the apical end, it would make no difference from which part of the stigma the tubes started, and the direction of growth after entering the ovoid or rounded cavity, other things being equal, would be dependent on chance alone. If sufficient viable pollen is applied to any part of the stigma, the thousand ovules (more or less) in the ovarian cavity may all be fertilized, unless some such condition as incompatibility or difference in state of receptivity intervened. If insufficient viable pollen is applied, then the ovules in any region equidistant from the apical end of the cavity will have an equal chance of being fertilized so long as there remain a sufficient number of pollen tubes. This would explain the uniform seed distribution in the fruits of *Cucurbita* spp. even if pollen was applied to one side of the stigma only.

The complete results will be published in the *Journal of Agricultural Research*.

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CHARLES T. O'ROURK, JUN.

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U.S. Department of Agriculture,
Field Laboratory,
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Feb. 4.

[1] Gustafson, F. G., *Amer. J. Bot.*, **25**, 237 (1938).

## Ferrous Iron in Soils

THERE has been a controversy in the literature concerning ferrous iron in soils on three points, namely: (1) Is ferrous iron present in large quantities in ordinary healthy soils? (2) Can soil fix iron in the divalent form? (3) Does the downward movement of iron in soils, such as the podsols, take place in the ferrous condition?

The details of the experiments undertaken to elucidate the problems outlined will be given elsewhere. In this communication merely the results and conclusions are presented. In all the work reported the ferrous iron was determined by the dipyridyl method[1], and the experiments were conducted on black chernozem and grey wooded podsol soils.

To study the formation of ferrous iron and its downward movement black and podsol loams were kept submerged under distilled water in percolators. During the first twenty-six days of the experiment no ferrous iron was found in the percolates. After the experiment had continued for sixty-five days small quantities of ferrous iron were found in some of the percolates, ranging from 9–27 gamma in the volumes of liquid collected during twenty-two hours. Only traces of ferrous iron were found in water extracts of portions of soil taken from the percolators.

The same portions of soil were then extracted with approximately 3 per cent solution of aluminium chloride. An average of 750 gamma of ferrous iron was extracted from 1 gm. of black loam and 425 gamma from 1 gm. of the podsol loam, these figures being given on the basis of oven-dried soil.

This experiment indicates that soils must be waterlogged for a considerable period of time before iron moves in the ferrous state, and that certain soils, at least, can hold a considerable amount of iron in the divalent form, which is not easily removed by water, but can be extracted by aluminium chloride solution. Approximately 75 per cent more ferrous iron was extracted from the black soil than from the podsol soil, indicating that the presence of organic matter under anærobic conditions encourages formation of ferrous iron.

In another experiment it was shown that from a solution of ferrous chloride approximately 1,500 gamma of ferrous iron were absorbed by 1 gm. of moist black loam, and 1,300 gamma by 1 gm. of moist podsol loam, within a two-hour period, the black loam absorbing all the iron supplied. After a twenty-four hour interval 10·56 *N* solutions of

potassium chloride, ammonium chloride and aluminium chloride released respectively 12 per cent, 15 per cent and 26 per cent of the ferrous iron absorbed by the podsol loam. In the case of black loam aluminium chloride solution released 8 per cent of the ferrous iron absorbed. The black loam absorbed more ferrous iron than the podsol loam, and the iron was retained more efficiently by the former than the latter. A part of the iron absorbed by these soils may have reverted to the trivalent insoluble form, as was suggested by Wilkoszewski[2], but a certain amount of iron remained in ferrous condition and was probably held in the base exchange complex.

The extraction of ferrous iron with potassium chloride, ammonium chloride and aluminium chloride solutions from samples of podsol loam in which formation of ferrous iron had been induced gave similar results. In this case *p*H values of the extracting solutions in contact with the soil were determined because the hydrogen ion concentration of these may have influenced the extraction of iron from the soil.

| | |
|---|---|
| *p*H of water .. .. | 7·4 |
| *p*H of KCl solution .. | 6·18 |
| *p*H of $NH_4Cl$ ,, .. | 5·92 |
| *pH* of $AlCl_3$ ,, .. | 2·92 |

From these results one may assume that ammonium and potassium displace the ferrous iron from the base exchange complex. Aluminium chloride solution, which is the best of the extracting agents used, may extract the iron from soil in two ways: by virtue of its high acidity and by displacement of ferrous iron by the aluminium cation.

Three per cent aluminium chloride solution extracts of soil surface (0–6 in.) and subsurface (12–18 in.) samples taken at widely divergent points showed, in the case of black soils, no ferrous iron or only traces; but in the case of podsol soils generally a little more, the figures ranging from traces to about seven parts per million for the surface samples and from traces to twelve parts per million for sub-surface samples, on the basis of oven-dried soil.

These figures show that only very small quantities of ferrous iron could be extracted from these soils. From the percolation and field experiments reported in this communication it may be suggested that the reduction of iron in soil has not been a major cause of downward movement of this element in podsol soils.

V. IGNATIEFF.

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Feb. 11.

[1] Ignatieff, V., *J. Soc. Chem. Ind.*, **56**, 407.
[2] Wilkoszewski, B., *Arch. der sci. Phys. et nat.*, **44**, 165.

## "Animal Treasure"

IN a review of my book "Animal Treasure" which appeared in NATURE on April 23, 1938, there occurred the passage "some of the statements have been seriously challenged by Mr. Arthur Loveridge in the *Scientific Monthly* of January 1938". I have just returned from a year's collecting trip to Surinam and have only recently seen both the review and the original criticisms mentioned.

I propose submitting a detailed reply to Mr. Loveridge's article in *Scientific Monthly* to the editor of that journal with the view of publication. There Mr. Loveridge made twenty criticisms in numbered paragraphs to prove that "Animal Treasure" was "to so large an extent a compound of misstatement, misinterpretation, exaggeration, sentimentalism and emotionalism". Since I am replying to Mr. Loveridge in detail elsewhere, I shall mention only a few points here. I feel, however, impelled to bring this to the notice of readers of NATURE, since Loveridge's article was mentioned in the NATURE review, and his criticisms have received widespread attention.

Perhaps the most important of Mr. Loveridge's criticisms is that I have blundered when he quotes from my book that: "We captured six diurnal animals in Africa that belonged to groups all the other members of which are exclusively nocturnal. All six animals—a snake (*Gastropyxis senaragdina*), a squirrel (*Funisciurus pœnsis*), a monkey (*Cercopithecus pogonias*), a rat (*Œnomys hypoxanthus*), a flying squirrel (*Anomalurus beecrofti*) and, finally, a lemur (*Galago demidovii*)—were bright green above and yellow beneath, whereas their near-related and nocturnal species were all of other colours" (p. 167). He states that the snake, squirrel and monkey belong to diurnal groups and none of the animals conform to my description except the snake, and "by courtesy" the squirrel. I regret the necessity of correcting Mr. Loveridge in these observations as all the animals referred to are bright greenish above and yellow below[1]. They still show the full yellow in the preserved specimens at the British Museum. The dorsal coloration has faded (as green always does) to olive or misty-grey-olive. Mr. Loveridge states that the pelage of mammals undergoes no radical changes on preservation beyond a slight dulling and fading with the passage of time, but here again I would point out that the reaction to which I have referred is, contrary to the view of Mr. Loveridge, well known to museum workers, furriers, etc.

Mr. Loveridge also states that I cannot even copy accurately from other authors. In "Animal Treasure" I referred (without quoting) to Mr. G. L. Bates as having found a male *Nectophryne batesii* sitting on a brood of eggs. Quoting from Dr. G. A. Boulenger, Mr. Loveridge claimed that Mr. Bates had found a female *N. batesii* with empty oviducts under the trough or hollow of a plantain-leaf petiole crouched in the midst of a mass of eggs. I accept Mr. Loveridge's quotation[2]; Dr. Boulenger's description is from Mr. Bates's original field notes. I had cause to examine this specimen, which is in the British Museum, and it proved to be a male as stated by Mr. H. W. Parker[3], assistant keeper in the British Museum (Natural History). Further, Mr. Loveridge's statement that the eggs were "beneath the base of a banana leaf apparently lying on the ground" is incorrect; a plantain-leaf petiole is customarily several feet from the ground.

"Animal Treasure" has never been claimed by me to be a purely scientific work, but as a popular introduction to the public of some of the wild life of West Africa.

All Mr. Loveridge's other criticisms, whether purely scientific or vaguely censorious, can be, and are being, refuted in like manner. It therefore seems necessary to point out that his judication rests merely upon his own opinions at present.

Full details of the actual scientific results will be found in the publications listed below[3,4,5,6,7,8].

A large work on the 1,500 mammals, with coloured plates of several species (notably the green and yellow monkey) and full details of all controversial points raised above is in the Press and shortly appearing as a volume of the *Transactions of the Zoological Society of London* (24). The reptiles, Mollusca, Myriapoda and certain arachnid groups are not yet worked out in full.

IVAN SANDERSON.

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Portland Square,
London, W.1.
Feb. 18.

[1] See Sanderson, *Trans. Zool. Soc. Lond.*, **24** (in the Press).
[2] *Ann. Mag. Nat. Hist.*, (8), **12**, 71.
[3] *Proc. Linn. Soc. Lond.*, **2**, 25 (1935).
[4] *Roy. Geog. Soc.*, **85**, 2 (1935).
[5] Parker, H. W., *Proc. Zool. Soc. Lond.*, **1**, 135 (1936).
[6] Sanderson, *Proc. Zool. Soc. Lond.*, **1**, 165 (1936).
[7] Roewer (on Opilionids), *Veröff. Deuts. Kolon-u. Uebersee Mus.*, Bremen, **1** (1936).
[8] Bayliss (on Parasitic Worms), *Ann. and Mag. Nat. Hist.*, (10), **17**, 257 (1936).

## Foam on the Dead Sea—and off the Mæander River

A FOAM-FORMATION like that described in NATURE of March 15, p. 468, is to be seen off the mouth of the Mæander (*Mendere*) River in western Asia Minor, when the river is in flood. The turbid river water establishes a sharp frontier with the clear sea-water, and when the breeze is on-shore, the sea-water *breaks* on the river water with sufficient force to accumulate a band of foam, several inches wide, which in turn retains scum and floating debris from the river. The foam band is carried by wind and current into arc-forms, which are the more conspicuous by reason of the contrast of water-colour within and without. For the salt and fresh waters do not readily mix, and the summary deposition of the silt at the point where the flood water is checked probably explains the very steep gradient of the delta escarpment.

Checked in front, the flood water escapes alongshore and retains its café-au-lait hue for many miles. I have encountered it south of the channel between Kos and Kavo-Krio (fifty miles), and west of Nikaria Island (sixty miles), according to the direction of the wind and resulting 'wind-rip' current. When the wind is between south-east and south-west, in the Ægean, the water is piled up to the north, and escapes by inshore channels; when the wind is in the north, the water is driven south, and is replaced by northerly currents inshore. Best known of these inshore currents is the famous and incalculable *'Gephýra'*, between Eubœa and the mainland of Greece.

JOHN L. MYRES.

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## Points from Foregoing Letters

PREPARATIONS of the succinic dehydrogenase are described by Sir F. Gowland Hopkins, C. Lutwak-Mann and E. J. Morgan which, while very active in reducing methylene blue, fail completely to induce an oxygen uptake in a system containing succinates, cytochrome *c* and cytochrome oxidase. It is clear, therefore, that some factor is necessary for transferring the hydrogen atoms activated by the enzymes to the cytochrome system.

M. Dixon and L. G. Zerfas state that cytochrome *c* is not reduced by the purified lactic dehydrogenase system of yeast, but that an additional intermediary catalyst is necessary and that this may play an important part in cell-respiration.

C-hypovitaminosis can be recognized by blood-test, by determining the concentration of the vitamin in serum, before and after the intravenous injection of 300 mgm. of ascorbic acid. According to A. Góth, in case of saturation, the value determined after two hours should be at least twice that previously found; if less, hypovitaminosis dominates.

J. Houston and S. K. Kon find that, in addition to free vitamin $B_1$, milk contains the substance also in a bound form, most probably as a vitamin $B_1$–protein complex.

Of many types of lactic acid bacteria studied by J. G. Davis, H. J. Rogers and C. C. Thiel, only *Str. fæcalis* and *Str. liquefaciens* invariably produced diacetyl from glucose, both under "resting" and under growing conditions. This finding is discussed in relation to the production of flavour in milk products.

Experiments indicating that progesterone has a greater ability of inhibiting the action of œstrone in the higher animals (baboon, monkey) than in lower animals (rabbit, mouse) are described by J. Gillman and H. B. Stein.

By analysis of the recoiling fragments of exploding uranium nuclei, E. Bretscher and L. G. Cook find that the existence of true 'trans-uranium' elements cannot generally be maintained. Results of observations on disintegration of thorium by neutrons are also given.

N. S. Bayliss and A. L. G. Rees find that the addition of foreign gases to bromine increases the intensity of the main bromine continuum by amounts from 7 per cent in the case of nitrogen to 25 per cent in the case of hydrogen chloride. The ultra-violet absorption of bromine is increased as much as ten-fold.

Defining *static interaction between particles* as the value of the interaction energy for zero particle velocity, E. C. G. Stueckelberg shows that for nuclear interaction its form is different from the static solution of the wave equation of the meson field.

Data submitted by D. H. Thompson show that the large-mouth black bass, *Huro salmoides*, introduced since 1929 in Lake Naivasha, Kenya, grows faster and is heavier than specimens of the same length in Illinois.

H. P. Traub and C. T. O'Rork, jun., find that pollen tubes enter the ovarian cavity of *Carica papaya* directly at the centre at the apical end, no matter which part of the stigma they started from. This explains the uniform distribution of the seeds in this and related families (Cucurbitaceæ).

Small amounts of ferrous iron (of the order of 0·1 per cent) have been extracted by V. Ignatieff from certain soils (black loam and podsol loam) which have been waterlogged for more than two months.

J. L. Myres points out that foam-formation like that described in NATURE of March 15, p. 468, in the Dead Sea occurs off the Mæander River in western Asia Minor, and is due to the breaking of the sea-water on the river water when the wind is on-shore.

# Research Items

### Excavations at Chametla, Sinaloa

In a report on three weeks' excavation in the vicinity of Chametla in the southern part of the State of Sinaloa, Miss Isabel T. Kelly describes a pioneer investigation which was undertaken under the auspices of the Institute of Social Sciences on behalf of the University of California (*Ibero-Americana*, **14**, 1938, Univ. California Press). Chametla lies on the Baluarte River, some kilometres down stream from Rosario. The modern unimportant village occupies a site which, according to contemporary accounts, was once the centre of a native State of some importance. It is to be assumed that the pre-white economy was purely agricultural. The valley abounds in low mounds, which mark former dwelling sites. There are also several large artificial mounds; but these were not examined. No architectural remains were found, though Oviedo reports adobe structures. There was no sign of metal, except a smooth disk, possibly a post-conquest copper coin. Axes, manos and chipped obsidian occurred; but the material was overwhelmingly ceramic. This pottery is of considerable intrinsic interest, excellent in quality and diversified in character—especially in view of its marginal location. The fundamental wares are a red-rimmed utility and black-banded wares, which persist through a succession of polychrome styles. In a tentative chronology the early occurrence of Chametla polychrome is well defined, while among later decorated wares, though distinct varieties are much confused, certain complexes with chronological significance appear to emerge. Apparently the succession does not endure down to conquest times. Even more surprising than its richness is the fact that this pottery is unique, and has no resemblance, generic or specific, to any known wares of other cultures. As to its provenance, having no affinities with Sonora to the north, nor the plateau on the east, while the Pacific lies to the west, the southern and coastal area alone remains. It would appear to be a spur of high culture along the coast, originating ultimately in Central America. But both the Chametla valley and the Pacific coast are at present *terræ incognitæ*.

### Anatomical Features of Fossil Skulls

Sir Arthur Keith has re-examined the anatomical features of the Piltdown skull and of the Swanscombe skull (*J. Anat.*, Jan. 1939). This is Part 2 and the concluding portion of a very careful and detailed analysis. The Piltdown skull reveals several simian characters that had been previously overlooked, and it exhibits a degree of asymmetry not equalled in modern man. The recognition of this asymmetry allows of a more satisfactory reconstruction being made. Its cranial capacity is now estimated at 1358 c.c. The author concludes that the Swanscombe, the Piltdown, London and Bury St. Edmunds skulls represent a related group which may be termed the Piltdown group and so far it has only been found in England. They are of a different group from that of Neanderthal man. Swanscombe man is older than Neanderthal man, unless the Heidelberg jaw is to be regarded as representing a Neanderthal type. Thus in early Pleistocene times the Pithecanthropic and Sinanthropic type was evolving in the east while the totally different Piltdown type was being evolved in the west. This latter general type continued into the mid-Pleistocene.

### Distribution of Antibody in Tissues

C. F. Wang and H. Wu (*Chinese J. Physiol.*, **13**, 429; 1938) have studied the antibody content of the different tissues of rabbits immunized with egg-albumin and have come to the following conclusions: (1) The maximum antibody content was found to be in the blood and in the tissues in the fifth to seventh week of immunization. (2) All the antibody could be removed from the tissue by perfusion. (3) The distribution of antibody in the tissues was in the following decreasing order: lungs, bone-marrow, kidneys, spleen, heart and liver. (4) Antibody was sometimes found in the uterus and testes. (5) No appreciable amount of antibody could be found in the stomach, brain or skeletal muscles. These findings are in harmony with the view that the antibody is formed in the organs of the reticulo-endothelial system.

### Acrodynia and Fatty Acids

F. W. Quackenbush, B. R. Platz and H. Steenbock (*J. Nutrition*, **17**, 115; 1939) found that on a basal diet of purified casein, glucose and salts, supplemented with carotene, calciferol, synthetic $B_1$ and riboflavin, rats developed skin lesions in 4–5 weeks; an acute dermatitis when restricted to the basal diet, and a chronic form, "rat acrodynia", when given fat supplements at subcurative levels. Complete healing of either the acute or chronic form was obtained by the administration of peanut oil or wheat-germ oil. Cured animals remained free from all symptoms while the fat supplements were continued or until the end of the survival period, which was usually several months. Aeration or ultra-violet radiations did not destroy the activity in peanut oil. It was resident in the fatty acid fraction. Cures were produced with half a drop of wheat-germ oil, corn oil or Wesson oil, 10 drops of coconut oil or 25 drops of butter fat. The lesions were not prevented or cured with hydrogenated coconut oil.

### Polygamous Weavers

R. E. and W. M. Moreau continue their valuable studies of the ecology of African birds by observations on the comparative habits of two weaver birds, *Euplectes nigroventris*, the Zanzibar red bishop, and *E. hordeacea*, the crimson-crowned bishop (*J. Anim. Ecol.*, **7**, 314; 1938). Both birds have breeding seasons shorter than the vegetation growth would allow, but the former already has young when temperatures are at their highest and continues to breed through the 'long rains' until the middle of the cool season, whereas the latter breeds only at the coolest months of the year. In neither species does the size or position of the breeding territory bear any relation to availability of food of adults or young nor has it regular topographical features, yet while the red bishop occupies constantly a relatively large territory (900 ± 300 sq. yd.), the

crimson-crowned territory may be compressed to under 10 sq. yd. Notwithstanding this relative divergence in spatial occupation, a male of the last named in its small kingdom has up to five breeding females active in it at the same time and raising up to eight clutches in a season, although the red bishop has never been found to have more than three wives in his large territory. Indeed, in the breeding population of both species females are in the ascendant, outnumbering males by quite four to one, and the authors are endeavouring to discover whether this curious disparity is due to differential birth rate or to subsequent mortality.

### Birds of Canton Island

CANTON ISLAND, one of the Phoenix Islands, is a low-lying coral atoll, 7 miles long by 4 miles broad, lying in a rainless belt 1,100 miles north-north-east of Fiji. Its birds were studied in 1889, and now again, in 1937, a second survey has been made, by Major G. A. Buddle (*Records Auckland Inst. Mus.*, **2**, 125; 1938). The survey shows few changes in close on half a century, as perhaps was to be expected on an island undisturbed by human visitors, and occupied only by sea-birds and passing migrants. Twenty species of birds are recorded. The wideawake terns described as breeding in large numbers in 1889 have completely disappeared, but terns are a fickle people. Neither the migratory turnstone nor sandpiper noted in 1889 was seen, but a new visitor was recorded in *Frigeta magnificens*. Major Buddle's observations were made from May 27 to June 8, 1937, during the visit of the New Zealand Total Solar Eclipse Expedition. Since then the British and American Governments have interested themselves in Canton Island as a probable air-base, and it is now permanently occupied by representatives of both peoples. Its bird life is likely to be considerably modified in the next fifty years.

### Advances in Indian Helminthology

SIX contributions to Indian helminthology have recently been made by Dr. Har Dayal Srivastava (*Indian J. Vet. Sci. and Animal Husbandry*, Dec. 1938). Two of them deal with amphistomes found in Indian food fishes and two new genera and another new species are described. One is an account of a new species of allocreadiid from *Chiloscyllium indicum*. Another describes a new gorgoderid trematode from *Belone strongylura*. The fifth is a study of the gasterostomatous parasites of Indian food fishes, and includes a key of the members of the genus *Bucephalus*; three species are here described for the first time. A new species of *Bucephalopsis* and two new species of *Prosorhynchus* are also described as well as additional details of other species of the former genus. The last paper is a study of the life-history, pathenogenicity and biological control of *Cotylophoron cotylophorum*, an important schistosome carried by the snail *Indoplanorbis exustus*.

### Nitrogen Content of Apple Trees

J. E. KENCH (*J. Pom. and Hort. Sci.*, **16**, 346; 1939) has investigated the content of nitrogenous materials in the terminal shoots of Lane's Prince Albert apple trees as affected by the five rootstocks *M II*, *M V*, *M VII*, *M IX*, and *M B*. The data show that the nitrogenous fractions in bark and wood were strikingly similar for all five rootstocks, and the variation from month to month did not differ significantly between stocks. The total nitrogen in the woody portions of the shoots, however, was higher for *M IX* than for the other stocks, which did not differ significantly from each other. Stock *M IX* seems to be associated with high amide content in the scion, especially in the young shoots, high asparagin content apparently being characteristic of this stock. The carbohydrate content of trees on *M IX* is also high relative to other stocks, and the carbohydrate/nitrogen ratios do not therefore differ appreciably. The seasonal cycles of the nitrogen fractions and C/N ratios are given and it is concluded that the chemical data, so far as terminal shoots are concerned, do not reflect the pomological differences between stocks. *M IX* alone induces any significant change in the chemical composition of the shoots of long-established trees.

### Anatomical Manifestations of a Virus Disease

THE first macroscopical symptom of many virus diseases is a clearing or yellowing of the veins of a host plant; but later, the green parts of a mosaic-mottled leaf may run along some of the larger veinlets. Miss F. M. L. Sheffield, of Rothamsted Experimental Station, has made anatomical studies of this apparent reversal of chlorophyll content in *Hyoscyamus* virus III as it attacks the tobacco plant (*Ann. App. Biol.*, **25**, No. 4, 781; 1938). The yellow colour of cleared veins is due to retardation of chlorophyll formation; no anatomical or cytological abnormalities occur at this stage. When bands of green tissue appear along the veins, however, the green parts are thicker than normal, whilst the interveinal yellow areas are thinner. Intracellular inclusions are abundant in all tissues except the xylem, but the virus is 6–11 times more concentrated in the yellow cleared tissue than in the green, banded tissue. The findings agree, in general, with those of other workers using different host-virus combinations.

### Tetraploid Pears

A BUD sport from the 'Fertility' pear ($2n = 34$) has occurred in Messrs. Seabrook's Nurseries. This new form, called 'Improved Fertility', exhibits increased size in all its parts. The average weight of each fruit is 197·5 gm. compared with 125 gm. in the original form. M. B. Crane and P. T. Thomas (*J. Genetics*, **37**, 287–300; 1939) have analysed the new form and found it to be a tetraploid $2n = 68$. This 'Improved Fertility' is more self-fertile than the original diploid form and may give rise to further desirable tetraploid varieties of pears. The diploid form, although known in commerce for sixty years, is comparatively unstable and sometimes shows aberrant cell divisions.

### Strength of the Earth's Outer Shells

R. A. DALY has recently reconsidered this question on a world-wide scale in the light of the evidence of gravity anomalies, the figure of the earth and physical geology (*Amer. J. Sci.*, **35**, 401; 1938). From recent data obtained by Hirvonen in the glaciated tract of north-west Europe "it appears that the asthenosphere can have at most only a minute fraction of the strength attributed to it by either Barrell or Jeffreys". The positive or negative loads would in this case have to be borne either by the earth's crust or by a 'centrospheric' shell, either or both of which would

need to have considerable strength, especially to shearing stress and bending moments. Further, the gravity anomalies obtained in peninsular India are hard to reconcile with the present earth model unless a triaxial figure of the earth is used, corresponding with one of those deduced by Hirvonen, Helmert, Berroth or Heikanen. The proposed new model also contains proportions of sial and crystalline sima to account for the facts of physical geology, the whole being supported on a vitreous substratum which has a configuration similar to the earth's geographical features but more accentuated, this substratum producing the isostatic compensation. The elevations in the vitreous substratum directly under the continents and mountain chains are called 'anti-roots'.

### Configuration of Chitosamine

CHITOSAMINE, the amino-hexose from chitin, has been alternatively described as glucosamine or mannosamine and numerous attempts to solve this problem of configuration have been made. W. N. Haworth, W. H. G. Lake and S. Peat (*J. Chem. Soc.*, 271; 1939) have now shown that a dimethyl 2 : 3-anhydromethyl mannoside gives rise, with alkali or sodium methoxide, to both a glucose derivative and an altrose derivative. The opening of the anhydro-ring in the dimethyl 2 : 3-anhydromethyl mannoside by ammonia gave rise to a derivative of 3-amino-altrose on the one hand and of 2-amino-glucose on the other. The latter substance was shown to be identical with chitosamine, which may now be considered configurationally to be glucose amine and therefore related to the parent sugar glucose.

### Deuterium Content of Mixtures

AN improved method of determining the deuterium content in mixtures of $H_2O$ and $D_2O$ is described by K. Linderstrøm-Lang, O. Jacobsen and G. Johansen (*C.R. Lab. Carlsberg, Série chimique*, **23**, No. 5; 1938). The apparatus consists of a vertical glass tube containing a heterogeneous mixture of kerosene and bromobenzene the density of which varies linearly with the height. One drop of the aqueous solution is added and falls to a position of equilibrium in which its density is equal to that of the medium there. The position of the drop is read off by a horizontal microscope and compared with the positions of standard drops of known densities. Only a very small amount of the water (1 cub. mm.) is required. The experimental procedure is described, particularly the purification of the water samples before measurement.

### Sliding Friction and the Contact between Surfaces

F. P. Bowden and L. Leben (*Proc. Roy. Soc.*, A, **169**, 371; 1939) have investigated in detail the sliding of one surface over another. The lower of two surfaces was moved slowly and very regularly, another surface was pressed against it and dragged against a spring control which measured the frictional force. It was found that the sliding always took place in a series of jerks. The upper surface was first carried forward with the same velocity as the lower, then there was a rapid slip, followed by a further period of sticking, and so on. This effect was observed with ordinarily clean surfaces and with surfaces lubricated with mineral oils. If certain long-chain fatty acids were used as lubricants, the sticking and slipping disappeared and motion became continuous. The friction between surfaces of like metals showed a large and violently fluctuating frictional force instead of the regular slipping and sticking. The experiments suggest that friction is due to a welding together of the materials at local points of contact. When the welded junctions are broken, the metal is distorted to a depth large on an atomic scale. Bowden and D. Faber, in the following paper, have estimated the area of contact between metal surfaces from the electrical resistance of the interface, and by visual examination of the impressions formed. They conclude that for flat stationary surfaces the area of intimate contact may be only 1/10,000 of the apparent area. The area of true contact is not greatly affected by the size, shape or roughness of the surface, but it depends mainly on the pressure. The local pressures are probably such that steel and similar materials undergo plastic deformation. Measurements made with moving surfaces show that the area of contact is not constant, but changes rapidly with the sticking and slipping of the sliding surfaces. The variations in contact area were compatible with the view that sliding consists in the alternate formation and rupture of metallic junctions.

### A Falling-Weight Time Switch

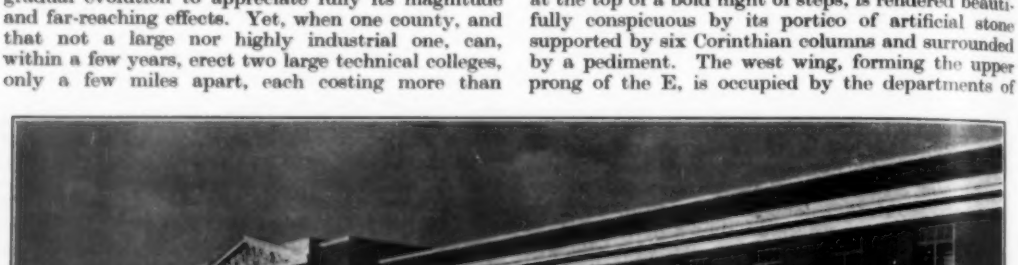
BEFORE a meeting of the Physical Society of London, held on March 10, Eric J. Irons read a paper prepared by him in co-operation with G. A. Bennet in which they described a falling-weight time switch. In this apparatus, the simultaneous release of two steel balls, the one from a fixed height and the other from a variable but known height $H$ effects the operation of two switches at a time interval which is shown to be a linear function of $\sqrt{H}$. An electrical circuit is arranged so that the fall of the first ball disconnects the battery and allows the condenser in circuit with it to discharge through a resistance $R$, until the impact of the second ball opens a switch and breaks the circuit. The potential difference between the plates of the condenser is estimated at this instant by observing the kick of the galvanometer which is simultaneously put in circuit with it. The logarithm of this value plotted against $\sqrt{H}$ gives a straight line, which substantiates the required relation and whose gradient yields the value of $g$ with an accuracy of one half of one per cent. In the second part of the paper, the authors explained the application of the two-sphere arrangement to the study of the relation between current and time in an inductive circuit.

### Colour Photography of the Lunar Eclipse of Nov. 7, 1938

B. BURRELL has recently published a paper with this title (*J. Brit. Astro. Assoc.*, **49**, 4; 1939) in which he describes the results of his records of this eclipse on colour-recording film. He used Agfacolor as a suitable material and obtained altogether forty-eight exposures, the telescope being a 3-inch refractor, mounted on an equatorial head. As there was no driving-clock, guiding was done by the finder; but this proved rather difficult, especially when the centre of the disk was in the umbra, as the eye was then dazzled by the strong penumbral light. A table shows the results obtained for various phases of the eclipse. The centre of the umbra at the beginning of totality was a very deep brown, shading to orange at the N. limb. Later the whole umbra brightened up considerably until about $0^h$, after which it remained constant.

# The South-West Essex Technical College and School of Art

WHEN the historian of the future makes a survey of the development of education in Great Britain, he will undoubtedly consider the rapid advance in all forms of technical education as the characteristic feature of the present period. We who live in the period may perhaps be too near the gradual evolution to appreciate fully its magnitude and far-reaching effects. Yet, when one county, and that not a large nor highly industrial one, can, within a few years, erect two large technical colleges, only a few miles apart, each costing more than £200,000 and accommodating 6,000 evening and 1,100 day students, there can be no doubt that this mechanized age has forced the pace of technical education very considerably.



The increased demand for more adequate facilities for practical education, together with the rapid development of many suburban districts due to the migration of the population, led the Essex Education Authority in 1933 to devise a regional scheme. The county was divided into four regions having centres at Colchester, Chelmsford, Dagenham and Walthamstow. Technical schools were already in existence in several districts, but to meet modern requirements, it was decided to enlarge and re-equip those at Colchester and Chelmsford and to erect entirely new buildings at Dagenham and Walthamstow. The South-East Essex Technical College, situated on spacious grounds on the south side of Longbridge Road about two miles from Barking station, was officially opened in 1936 and a brief account of this huge college appeared in NATURE of March 27, 1937. The fourth region is served by the South-West Essex Technical College and School of Art, situated on a large site in Forest Road, Walthamstow. This magnificent edifice was opened on February 28, 1939, by the Right Hon. The Earl de la Warr, president of the Board of Education. It is designed to serve the Boroughs of Walthamstow, Leyton, Chingford and Wanstead and Woodford together with the smaller districts of Waltham, Epping and Ongar.

The building is, in plan, shaped like the letter E and faces south. It covers an area of two and a quarter acres and is designed in the Georgian style, faced with multi-coloured bricks that contrast with the rusticated plinth, cornice and window dressings. It contains four floors, and the main entrance, placed at the top of a bold flight of steps, is rendered beautifully conspicuous by its portico of artificial stone supported by six Corinthian columns and surrounded by a pediment. The west wing, forming the upper prong of the E, is occupied by the departments of science, commerce, domestic science and building, with a well-equipped gymnasium at the north end. In the east wing are to be found the School of Art and, at the northern extremity, a second gymnasium. Between the two gymnasia, provision in the form of a separate one-story building has been made for the engineering workshops. The central prong of the E actually forms the main axis of the College and contains the large and spacious assembly hall on the ground floor with the swimming bath below in the basement, and above, the library on the first floor with a refectory and kitchens on the second floor. The great hall, 100 ft. long, 55 ft. wide and 22 ft. high, will seat more than one thousand people and is provided, at the north end, with a stage 20 ft. deep completely equipped for modern dramatic and operatic productions. The swimming pool, fitted with springboards, diving stage, changing and shower rooms, is 100 ft. by 42 ft. and is illuminated by specially devised ceiling lights.

The frontage block—the vertical stroke of the E—contains staff rooms in the basement; chemical and physical laboratories, with storage and lecture rooms on the lower ground floor; administrative offices, board-room, etc., on the ground floor, and above, on the top floor, special rooms for bookkeeping, commodities and retail trades. One special room should be noted in this block. On the ground floor nearly opposite the board-room is the nursery where mothers may leave their children in the care of a trained nurse

while they are attending classes! The corridor floors are covered with grey mottled rubber to render the movement of students as silent as possible, and supplementary to the main staircases, passenger lifts have been installed.

It was John Ruskin who wrote, many years ago, "The entire object of true education is to make people not merely do the right things but enjoy the right things". Yet, the pioneers of technical education were mainly concerned with providing a training which was severely utilitarian. But, as Dr. H. Lowery, the principal of the College, aptly points out, "A new problem . . . has arisen—it becomes necessary to provide training for *leisure* as well as for *vocation*". Here then is a new function implying heavy responsibilities for the modern college. It is essential to recognize and to cater for the proper use of leisure, and here, in this magnificent new institution, ample opportunities are afforded for developing the true recreational and communal spirit. To quote Dr. Lowery again, "it is our desire that the College shall become one great educational and recreational community centre where men and women may meet in their leisure time for the purpose of engaging in matters of common interest, thereby securing the fullest opportunity for self-expression".

The material building of this huge college has been very efficiently carried out by the general contractors, Messrs. F. R. Hipperson and Son, Ltd., of London, to the plans of Mr. J. Stuart, the architect, but an even greater work will now be undertaken by the principal and his large staff in laying the foundations of another edifice which will undoubtedly reveal itself in the trained mind, skilled craftsmanship, cultured recreation and, what is most important of all, trustworthiness and reliability of character. As R. W. Dale once wrote: "The immediately possible is hardly worth living for. It is the ideal that kindles enthusiasm and gives inspiration and vigour to all human effort". F. G. W. B.

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# Peneplains and Related Land Forms

IT is now nearly fifty years since W. M. Davis introduced the term 'peneplain' for the surface of low relief which might be expected to mark the end-stages of a long period of sub-aerial erosion under stable conditions. The term was received with a certain suspicion and lack of cordiality among British workers and it has been used comparatively little in their writings. Geographers and geomorphologists will therefore note with interest that the Geological Society recently discussed some of the questions at issue.

In introducing the subject, Dr. F. Dixey's main contention was that the term 'peneplain' is properly applicable to local areas which, though extensive, are far from being of continental dimensions. The common presentation of a cycle of erosion as running its course in a region of homogeneous rocks and resulting ultimately in the base-levelling of a whole land mass leads, in his view, to an unwarrantable attempt to limit the application of the term peneplain. He directed attention to the "two-peneplain topography" described by A. D. Coombe in Uganda, and common indeed throughout Africa, and he showed that such conditions must inevitably arise where weak and resistant rock-masses are juxtaposed. The lower surface opened out in weaker rocks, such, for example, as infaulted strips of Karroo sediments, may have the characteristics of a true peneplain, even though locally interrupted by residual masses and abutting elsewhere against steep slopes. Thus there arose veritable flights of peneplains as between the northern end of the Nyasa rift and the Luangwa valley. Here the following erosion surfaces are distinguishable: a late Jurassic surface at about 7,000 ft., a late Cretaceous or Early Tertiary surface at 5,000 ft., a Miocene surface at 4,000 ft., and a late Tertiary surface developed at about 3,000 ft. on friable Cretaceous rocks in local troughs. Further, a sub-Cretaceous surface has been exhumed locally by erosion and stands at about 2,000 ft. This surface and the late Tertiary surface rank as local peneplains in Dr. Dixey's sense, though others have denied them such rank because they are enclosed by highland areas.

Most other contributors to the discussion expressed agreement with Dr. Dixey, and Mr. J. M. Edmonds described somewhat comparable conditions in the Anglo-Egyptian Sudan. Dr. K. C. Dunham, however, noted that the Rio Grande and the Gila River are flanked by erosion surfaces, up to 80 miles long and 30 miles wide, produced by lateral corrasion. These would apparently rank as local peneplains in Dixey's scheme, but he thought this constituted an extension of the term peneplain and one unlikely to prove acceptable to American workers.

The discussion ranged widely over other cognate matters and several points of view were represented. Prof. O. T. Jones deplored the lack of any agreed definition of the features of a peneplain. He maintained that, in one sense, the whole of England and most of Wales is a peneplain rising gently from sea-level to more than 2,000 ft., and truncating all formations from the Pre-Cambrian to the Pliocene. Despite the considerable relief of parts of this surface, such relief can scarcely amount to 10 per cent of the thickness of strata removed by erosion. He also emphasized the probable importance of wind erosion in producing extensive surfaces of low relief.

Other speakers were, by implication at least, unwilling to accept so wide and general a connotation for the term 'peneplain'. Dr. Hollingworth pointed out that Davis's conception of a single peneplain in the Appalachian region is now challenged by several alternative and mutually inconsistent interpretations, most of which agree, at least, in representing the surface as complex and composite. Similarly, Mr. J. F. N. Green expressed the belief that many surfaces in the south of England which might be regarded as peneplains on general inspection have proved susceptible of dissection into distinct terrace-like features, separated by bluffs. Mr. A. A. Miller and Dr. S. W. Wooldridge raised a further issue in pointing out that many of the 'high-level platforms' of Britain, as well as most of the 'fossil' surfaces,

that is, exhumed planes of unconformity, have been finished, if not formed, by marine agency. In many such cases it is clear that the drainage pattern has not been inherited from a previous cycle, as must inevitably be the case with a true peneplain. Thus, closely spaced wind-gaps in the Old Red Sandstone ridges of southern Ireland indicate a consequent drainage initiated upon the surface which bevelled the structures. Similarly, the transection of anticlinal lines by rivers in southern England indicates that over wide areas the drainage originated upon the emergent floor of a Pliocene sea. Nevertheless, the whole of the region was not submerged; in parts of the Chalk areas of Wessex and the central Wealden area the reconstructed hill-top plane reveals the characteristics of a true peneplain and the drainage was adjusted accordingly. It seems, moreover, that the Thames in earlier stages of its history cut wide benches by lateral corrasion which may fairly be grouped with Crickmay's 'panplains' and the American examples adduced by Dr. Dunham.

The discussion gave a clear indication, if such be needed, that the findings of geomorphology in the field of erosion surfaces now challenge the close attention of the stratigraphical geologist and the geophysicist. Erosion surfaces, some trimmed by marine erosion and others demonstrably of sub-aerial origin, have been proved to have a wide extension and to maintain essentially unwarped attitudes over great distances. As such, they constitute an important record of the later geological history of the continents, supplementing the sometimes scanty evidence of deposition. Further, their existence cannot be ignored by those who seek to understand the nature and extent of isostatic adjustment in the lithosphere.

S. W. WOOLDRIDGE.

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# Physics in the Textile Industries

RESEARCH physicists working in industry continue to increase in number, and the Institute of Physics, by holding conferences on industrial physics, does much to bring them together to discuss their mutual problems. But the conferences are open to all interested, and the physicist has opportunities of making contacts with those of other professions whose problems are essentially physical.

The third conference, held in Leeds during March 23–25, was devoted to "Physics in the Textile Industries". The textile industries have been built up by many years of experimenting coupled with notable inventions, and it has behind it a wealth of knowledge which must be learnt by the physicist if his work is to be of utmost advantage to the industry. Meetings such as that held in Leeds are thus of great value in enabling the physicist to discuss problems not only with other physicists, but also with those conversant with the industry. Simultaneously, the industrial technical man has an opportunity of learning possible applications of physics and physical devices to his industry. This is particularly important for the older textile industries, where few factories have physicists on their permanent staff, and advances which physics has to offer must be introduced and cared for by the technical men.

The conference was held in the Physics Department of the University of Leeds. It was formally opened by the Vice-Chancellor, Mr. B. Mouat Jones, and was presided over by Prof. R. Whiddington. Following established practice of the Institute, the lectures and discussions were informal, and will not all be published.

The formal opening was followed by an address by Prof. Whiddington on "The Physics of Humidity". He discussed with demonstrations the properties of the small but important amounts of water in the atmosphere, and indicated why relative humidity is for the textile industries a much more convenient measure of the quantity of water vapour in the air than the fundamental measure, vapour pressure. He then described properties of substances dependent on water content, and illustrated experimentally the large heat effects associated with change in water content of textile fibres. He concluded with an experiment showing the swelling of a wool fibre with increase of water content, using as a micrometer the capacity of a condenser in a heterodyne circuit. Thursday morning's programme was completed by a lecture from Dr. Ezer Griffiths, of the National Physical Laboratory, on "Industrial Humidity Control and Measurement". He illustrated with many slides the requirements of humidifying plant and humidity controls, and described the various ways of measuring relative humidity, indicating the method most convenient to each industrial process where this is important.

The afternoon of March 23 was devoted to a visit to the Department of Textile Industries in the University, followed by Dr. C. C. Paterson's presidential address to the Institute of Physics. He chose as his subject "Colour and Colour Rendering". This was a lecture of exceptionally beautiful and instructive demonstrations. Dr. Paterson pointed out the high efficiency attainable from discharge tube lamps, and contrasted their spectra and colour-rendering properties with daylight and other sources of illumination. The colour triangle and C.I.E. units were simply and elegantly explained, and there followed striking demonstrations of the difference between matched white lights for colour rendering. He pointed out that the appraisement of colour matching value is a pressing but unsolved problem. The lecture concluded with illustrations of the improvement in colour quality and efficiency attainable in discharge tube lamps by use of fluorescent materials.

The lectures on March 24 were by Dr. M. C. Marsh, of the Cambridge Instrument Co., Ltd., who chose "The Contribution of Physics to the Development of Industrial Process Control", and by Mr. D. Harrison, who spoke on "Automatic Regulators for the Textile Industries". These lectures brought to the notice of all the many instruments now available for industry, and features of their design gave an impressive illustration of the potentialities of physical knowledge when applied to industry.

The final lecture of the meeting was on "Heat Effects in Fibres and other Systems". It was given by Dr. C. G. Darwin, director of the National Physical Laboratory. It was a delightful lecture on a difficult

and controversial subject. Kinetic effects have of recent years been used to explain the long-range elasticity of many natural substances, particularly rubber, and suggestions have from time to time been made that the same principles may lie behind the exceptional elasticity of muscle, wool fibres, and various synthetic materials. Dr. Darwin outlined the thermodynamic and statistical arguments of equipartition of energy and entropy, and used them in a critical survey of explanations of long-range elasticity. He showed, too, how these same kinetic principles led to the use of adiabatic demagnetization for attainment of very deep temperatures.

On Friday evening and Saturday morning, members of the Conference saw much of science in the textile industries at the laboratories of the Wool Industries Research Association. Alternative visits on Saturday morning to the Bradford Conditioning House and to Messrs. Prince-Smith and Stells, Ltd., Keighley, enabled members to appreciate the extent of testing of textile materials, and the ingenuity that has been used in design of textile machinery.

An exhibition of apparatus, instruments and books cognate to the subject of the conference was held in the physics laboratories of the University. Twenty-six firms and research organizations, including the National Physical Laboratory, had stands at the Exhibition. A special section devoted to popular applications of physics calculated to demonstrate its varied application to everyday matters, especially in the manufacture and use of textiles, aroused much interest. Representative instrument makers contributed exhibits which served to show how many and varied are the instruments available to help the textile manufacturer overcome many of the difficulties inherent in producing a uniform product from variable raw materials. The exhibition was of inestimable value in suggesting to textile manufacturers the large variety of problems that physics may tackle.

The Institute of Physics assumed a difficult task in choosing "Physics in the Textile Industries" as the subject for its third conference. Physics is becoming better recognized by textile manufacturers, but its progress in the industry has proved difficult and slow. The success of the conference and the attention it has attracted should advance the application of physics in one of the largest industries of Great Britain, and in turn help it to meet ever-increasing competition from abroad. A. B. D. CASSIE.

## Forest Administration in Malaya

THE Forestry Department of the Straits Settlements and the Federated Malay States was organized in 1901 and the Malayan Forest Service, which includes all senior officers serving in Malaya, was created in 1926. Afterwards, the protected States of Johore (1920), Kedah (1923), Kelantan (1933), Brunei (1933) and Trengganu (1936) set up forestry departments of their own, to the charge of which officers of the Malayan Forest Service were appointed. A Research Branch was commenced in 1918, and has greatly developed and undertaken important work, its sections now consisting of botany, wood anatomy, sylviculture, chemistry, entomology, forest economy and timber testing. In connexion with the Research Branch, a vernacular school is maintained for the training of the subordinate staff. The Research Branch and School are now much on the same lines as the classic example at Dehra Dun, India.

Decentralization took place in 1935, and the Malayan forest organization is now defined as a group of ten forest departments held together by a common and interchangeable staff of trained officers "with a central coordinating body (including the director of forestry), with executive control in some territories and advisory duties in others, that always exerts some influence towards co-operation and a broadly common forest policy". So long as the central co-ordinating body is listened to, progress in the future should be as good and better than the past. But decentralization is a dangerous thing in forestry—as can be seen in many parts of the forestry world in the British Empire. The required area of forests to be reserved in the interest of the individual country as a whole, stock mapping in forests under exploitation or shortly to be exploited, and, that safeguard of the forests, the working plan—these three essentials to a correct administration of a country are in one or more cases, and often in all three, lagging seriously behind what is needed in many parts of the Empire.

When this is the position—and in how much of our Empire outside India is this the case—decentralization and the withdrawal or even lightening of the control of a central authority responsible for a large region of country is seriously to be deprecated.

That this latter contention merits attention is shown by the statement contained in the "Annual Report on Forest Administration in Malaya for 1937" (F.M.S. Govt. Press, Kuala Lumpur, 1938). The Director writes, "Some uneasiness has however been caused by sudden and unexpected demands for the release of extensive areas that have always been regarded as permanent reserves. Thus, in Tahang the Tekai reserve of 83,000 acres had to be relinquished for inclusion in the King George V National Park, in this way preventing the exploitation of some particularly good *merbau* forest, conveniently situated near the railway. In Perak practically the whole of Pasir Panjang Ulu reserve of 19,000 acres was earmarked for a *padi* irrigation scheme, innumerable applications were received for permits to prospect for minerals and a strong bid was made by Sakai to settle in an old-established reserve that is by no means too large to meet the needs of the surrounding population and in which regeneration operations have been carried out for years at considerable expense to Government. This department is far from being unsympathetic to the claims of these various communities and realizes that adjustments will be necessary, but the long-range policy that is inseparable from conservative forestry makes it imperative that conflicting interests should be planned far enough in advance to enable systematic forest operations to be undertaken with some prospect of fruition".

Sympathy may be expressed with a department placed in such a situation, but the forestry authorities do not appear to understand that it is one of the objects of and duties of the working plan to safeguard forests from calamities of this type and others.

On the subject of working plans, the Director writes, after alluding to plans for the mangrove forests of Perak and Selangor, "Whereas the plans for the mangrove follow the usual pattern, those for inland forests are much less detailed and will continue so until greater stability is reached in the consuming industries and the threat of revocation is removed. Reference has been made (above) to the existing uncertainty with regard to the permanence of tenure, without which no serious planning is possible".

Why ? This was not the policy followed in India ; nor is it in Europe. In the centre of France a fine beech forest exists. There is also an industry working out kaolin within the forest. A working plan has been in force for the area for more than eighty years ; and yet the manager of the kaolin industry can come to the forest officer any day and say he wants to commence to excavate at such and such spot, thereby involving one or more compartments, which necessitates some adjustments in the working plan and possibly of the yield for some years to come. Once a working plan has been sanctioned for an area of forest by the central authority the latter is not so ready to go back on a considered policy. Areas now threatened in Malaya might never have come into this unenviable position had they been placed under a working plan.

This report is of considerable interest and contains abridged reports of the activities of the Forest Departments of Johore, Kedah, Kelantan, Trengganu and Brunei.

## University Events

CAMBRIDGE.—At a special congregation to be held on June 6, it is proposed to confer the honorary degree of Sc.D. on Prof. W. N. Haworth, Mason professor of chemistry in the University of Birmingham, and on Sir Henry Dale of Trinity College, director of the National Institute for Medical Research, London.

At King's College, Dr. A. E. Alexander has been elected to a fellowship. Dr. Alexander, who was educated at Brockenhurst County School and the University of Reading, obtained a first class in Part II (Chemistry) of the Natural Sciences Tripos in 1935 and was awarded the Gordon Wigan Prize in 1937. He was elected to a Ramsay Memorial fellowship in 1937 and now holds a Rockefeller travelling fellowship.

LONDON.—Dr. G. A. D. Haslewood has been appointed to the University readership in biochemistry tenable at Guy's Hospital Medical School. Since 1935 he has been assistant in pathological chemistry at the British Postgraduate Medical School.

Mr. P. A. Sheppard has been appointed to the University readership in meteorology tenable at the Imperial College of Science and Technology. Since 1934 he has been technical officer in the Department of Meteorology at the Chemical Defence Experimental Station, Porton.

It has been resolved to institute a certificate of proficiency in natural history, and regulations have now been adopted for it.

SHEFFIELD.—Dr. J. Monteath Robertson has been appointed lecturer in physical chemistry, in succession to Dr. S. Glasstone, who has resigned.

## Science News a Century Ago

### Photography in Germany

WRITING from Paris on April 2, 1839, a foreign correspondent of the *Athenæum* said : "The announcement of Daguerre's discovery has turned the brains of half the world : you sober English have certainly not escaped the infection ; and the speculating Germans, as you have noticed, are hard at it. I learn, by letters just received from Munich, that Profs. Steinhel and Robel are astonishing the natives with their Photogenic pictures. It is *said* that they have discovered the process of the Daguerre, but it seems to me more than probable that their process rather resembles that of Mr. Talbot ; and that by their invention pictures can be obtained not only with the aid of the camera obscura but by the direct agency of light so that they take, in an instant, copies of pictures traced upon blackened glass. . . . Daguerre's pictures are, it is known, traced upon copper (?) but Messrs. Steinhel and Robel imprint theirs upon paper."

### Application of Döbereiner's Discovery

IN a letter to the *Mechanics' Magazine*, sent from Sandwich on April 5, 1839, W. H. Weekes referred to "a suggestion of my own made many years since, with a view to effect the simultaneous lighting of street lamps throughout a town or district". Weekes had been accustomed, by means of a private press, to keep memoranda in printed form, and one of these dated January 24, 1826, he sent to the editor of the journal. In this memorandum he had written : "One of the most interesting facts as connected with the recent advancement of modern chemical science, perhaps, is the important discovery of that intelligent continental philosopher Döbereiner, who has ascertained the peculiar property of *spongy platinum* to become ignited by exposure to the action of a stream of hydrogen gas, and the consequent inflammation of the gas itself, from contact with the ignited metal ; thus furnishing a most ingenious, elegant and useful mode of obtaining instantaneous light. . . . Now, will similar results obtain from the action of *spongy platinum* on the gaseous compound carburetted hydrogen or coal gas ? Of this I think there can be little doubt, and if proved the spongy platinum may unquestionably be rendered applicable to the purpose of lighting street lamps spontaneously."

Johann Wolfgang Döbereiner, the German chemist who discovered the property of spongy platinum referred to, was born December 15, 1780, and died March 24, 1849.

### Seasons and Infantile Mortality

THE issue of the *British and Foreign Medical Review* of April 1839 contains the following information : "The season of the year evidently exercises great influence on the rate of the mortality of children. According to Trevisan, of 100 children born in Italy in the winter 66 die in the first month, and only 19 survive the first year ; on the other hand, of 100 children born in summer so many as 83 survive the first year, of 100 born in the spring 48, of 100 born in the autumn 58. In Belgium the rate of mortality in the first month of children born in January, compared with that of children born in July is 33·21 to 17·19."

# Societies and Academies

## London

Royal Society (*Proc.*, B, **127**, 1–139; 1939).

T. SVEDBERG and others: A discussion on the protein molecule.

F. C. COURTICE, C. G. DOUGLAS and J. G. PRIESTLEY: Carbohydrate metabolism and muscular exercise.

W. S. STILES: Directional sensitivity of the retina, and the spectral sensitivities of the rods and cones.

C. RIMINGTON: A re-investigation of turacin, the copper porphyrin pigment of certain birds belonging to the Musophagidæ.

P. K. DE: Role of blue-green algæ in nitrogen fixation in rice-fields.

## Paris

Academy of Sciences (*C.R.*, **208**, 609–684, Feb. 27, 1939).

A. LACROIX: Submarine volcanoes, in connexion with some rhyolitic pumices collected on the atoll Marutea du Sud (Tuamotu Archipelago).

R. ROSCA: Asymptotic transformations of curves in elliptic space.

A. TERRACINI: Existence of surfaces having given principal lines.

J. TOUCHARD: Differential equation of third order sines.

G. KOWALEWSKI: An unknown property of the plane projective group.

V. ROMANOVSKY: Eddies in thick sediments: application to polygonal strata of the Arctic. Layers of sugar, salt or sand, covered with a layer of water and heated nearly to boiling point, give convection 'cells' identical in form with the polygonally marked areas of Greenland and Spitsbergen.

L. ESCANDE: Experiments on the outflow of a weir barrage.

G. DEDEBANT and P. WEHRLÉ: Definition of turbulence.

J. VILLEY and R. JAMIN: Law of variation of the force opposed by the air to the translation of a movable body.

H. MINEUR: Evolution of galactic clusters.

H. GROUILLER: Photographic and colorimetric photometry of the eclipsing double star β Lyræ.

J. VIGNAL: Probable chief cause of imperfection of modern levellings.

I. OPATOWSKI: Integration of the equations of motion of an electrified particle of variable mass subjected to the action of electric or magnetic fields of any kind.

J. MARIANI: Existence of an elementary quantum of length.

L. NÉEL and B. PERSOZ: New method of measuring true specific heats of metals at high temperature. The metal in the form of a wire, 0·5 mm. thick and 10 cm. long, in a furnace at a given temperature is heated by an intense current for about 0·1 sec. and the rise of temperature measured by using the wire as a branch of a double Thomson bridge.

S. NIKITINE: Theory of transversal photodichroism.

P. SAVITCH: A gaseous radio-element formed by the bombardment of uranium by neutrons. The new element is a gas emitting β-radiation and its period is about 20 min.

F. JOLIOT: Observation by the Wilson method of the cloud trajectories of the products of the explosion of the uranium nucleus. On one photograph out of 902 taken, a track indicating an atom of ionizing power four times that of an alpha-ray was found.

T. KAHAN: Transmutations of light nuclei and their theoretical interpretation. A series of reactions in cascade is suggested.

J. THIBAUD and A. MOUSSA: Disintegration of uranium by neutrons and the partition of this element. Chemical separation shows that uranium breaks up into lanthanum and bromine, which are transformed by a series of β-disintegrations into strontium and a rare earth respectively. Particles of energy of the order of 50 Mev. are released.

A. DOGNON and C. PIFFAULT: Absence of denaturation by heat of superficial solutions of serum albumin.

F. PUCHE: Thermal dissociation of cæsium palladium dichloride.

J. BOUGAULT, E. CATTELAIN and P. CHABRIER: Action of Raney nickel on some organic sulphur compounds.

M. BASSIÈRE: Crystalline structure of the azides: constitution of the azohydric anion.

R. COMBES and MLLE. M.-T. GERTRUDE: Action of alpine climate on plant metabolism. Exposure to low temperature at night or to alpine conditions has similar effects on habit of growth and also leads to accumulation of soluble glucides.

R. ULRICH: Quantitative variations of fatty acids, sterols and phospholipids during maturation of the fruits of ivy.

A. DEMOLON and H. BURGEVIN: Utilization of fertilizer elements in the production of the grain of cereals: role of straw.

J. VELLARD: Variations of globulin resistance *in vivo* under the influence of snake venoms.

MLLES. A. RAFFY and R. RICART: Influence of variations of salinity on oxygen consumption in cephalopods.

J. LAIGRET and R. DURAND: Modification of pathogenic activity of two strains of rat typhus virus maintained by passage through white mice. A dried stable product can be prepared which may perhaps be suitable for inoculation of man against typhus.

G. HORNUS: Experimental pulmonary psittacosis of white mice.

L.-A. MARTIN: Adsorption of the virus of the infectious anæmia of the Equidæ on aluminium hydroxide.

W. KOPACZEWSKI: A particular modality of phenomena of shock.

A. BESREDKA. Local cutaneous bacterio-therapy in rabbit epithelioma (Brown-Pearce).

## Moscow

Academy of Sciences (*C.R.*, **20**, No. 6, 1938).

A. G. PINSKER: A function in the space of Hilbert.

A. B. SEVERNY: Gravitational instability of a material sphere.

N. MOISSEIEV: (1) Construction of stability regions in Liapounoff's sense. (2) Stability regions in the space of phases.

A. ALICHANOV, A. ALICHANIAN and M. KOZODAEV: Measurement of $e/m_0$ for β-particles of RaC.

A. ALICHANOV and G. LATYSHEV: Spectrum of RaC positrons.

Vs. ČERNIAJEV: (1) Wave-length measurements of deuterium and hydrogen Balmer lines. (2) Influence of noble gases on the intensity of lines of hydrogen and deuterium Balmer series.

V. FABRIKANT and G. ROKHLIN: Effect of magnetic field upon the radiation of mercury discharge.

V. FABRIKANT and K. PANEVKIN: Excitation of atoms in a discharge of rare gases.

W. LEWSCHIN and E. RICKMANN: Investigation of the phosphorescence mechanism of samarium phosphorescent substances by studying the deterioration of their luminescence.

N. BALASCHOWA and A. FRUMKIN: Electro-kinetic behaviour of platinum at different potentials.

N. A. FIGUROWSKY: Method for determination of the differential volume of pores of porous bodies.

N. A. ŠIŠAKOV: Mosaic flocus of silicate glasses.

M. A. ILJINSKY: Characteristics of the phenomena taking place at the boundary line between two solid phases in an indifferent liquid medium.

V. I. NIKOLAEV and S. K. KALININ: Strontium as a chemical indicator.

K. M. GORBUNOVA: Deposition of metals on monocrystals.

P. A. ZEMIATCHENSKY: Problem of the origin of kaolin.

G. V. SAMOKHVALOVA: Influence of low temperatures on fish.

M. N. MEISSEL: Alterations of chondriosomes of yeast organisms in the course of respiration and fermentation.

N. V. SEMIGANOVSKAIA: Dependence of the development of wheat plant on the geographical origin of the seed.

S. S. SMIRNOV: Question of glacial-masine relics in fresh-water fauna.

A. N. STOUDITSKY: (1) Thyreotropic response in the chick embryo. (2) Parathyreotropic response in the chick embryo.

M. P. AIZUPET: Regeneration processes in the developing bone.

Z. IGNATIEVA: Differentiation of neuroblasts in cultures.

### Tokyo

Imperial Academy (*Proc.*, 15, No. 1, 1–21; 1939).

SHŌKICHI IYANAGA: Proof of the invariance of fundamental groups by the subdivision of complexes.

KAKUJI GOTO and HIDEO SHISHIDO: Constitution of tuduranine. This is an accessory alkaloid of sinomenine in the root of *Simonenium acutum* Rehd. et Wils., and is shown to be the l-form of 3-oxy-5, 6-dimethoxy-N-nor-aporphine.

KOZO HIROTA and JURO HORIUTI: An electrical phenomenon of a palladium filament occluding hydrogen.

YOSHIKAZU TOYOHARA: Inclination of the strand along a sandy seashore.

SOICHI FUKUDA: Acceleration of development of the silkworm ovary by transplantation into the young pupa. Rapid development is obtained by transplantation into a pupa of either sex, regardless of the presence or absence of gonads.

## Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

PROFESSOR OF ECONOMICS in University College, Swansea—The Registrar (April 3).

JUNIOR LECTURER IN SCIENCE (advanced electrical theory) in the Royal Military Academy, Woolwich—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (April 8).

LECTURER IN HORTICULTURE AND NATURE STUDY in the Strandhills Training College, Belfast—The Principal (April 15).

ASSISTANT LECTURER IN DOMESTIC SUBJECTS in the University of Reading—The Registrar (April 17).

LECTURER IN PHYSICS in the School of Science, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (May 15).

## Reports and other Publications

*(not included in the monthly Books Supplement)*

### Great Britain and Ireland

Liverpool Observatory and Tidal Institute. Annual Report, 1938. Pp. 18+3 plates. (Liverpool: Liverpool Observatory.) [90

Monographs of the Geological Department of the Hunterian Museum, Glasgow University. 5: On a Second Collection of Fossils and Rocks from Kenya made by Miss M. McKinnon Wood. With some further Geological Observations on the Coastlands of Kenya, by Miss McKinnon Wood, and Reports on the Collections by Dr. Ethel D. Currie, Dr. J. W. Gregory, C. D. Ovey, Dr. G. W. Tyrrell and Agnes T. Nelson, Dr. J. Weir, and Dr. S. Williams. (Glasgow University Publications, 49.) Pp. iv+116+12 plates. (Glasgow: Jackson, Son and Co.) [90

Home Office. Report on the Psychological Treatment of Crime. By Dr. W. Norwood East and W. H. de B. Hubert. Pp. iii+166. (London: H.M. Stationery Office.) 2*s.* 6*d.* net. [90

### Other Countries

University of Colorado Studies. Series B: Studies in the Humanities. Vol. 1, No. 1: Edmund Burke and his Kinsmen; a Study of the Statesman's Financial Integrity and Private Relationships. By Dixon Wector. Pp. 113. (Boulder, Colo.: University of Colorado.) 1 dollar. [63

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 42, Part 3: On the Nematoda-Parasites of the Pacific Ocean. By Tsunenobu Fujita. Pp. 239–266+plates 10–14. (Tokyo: Maruzen Co., Ltd.) [63

Bernice P. Bishop Museum. Bulletin 152: Distribution and Variation of *Achatinella mustelina* Mighels in the Waianæ Mountains, Oahu. By D'Alte A. Welch. Pp. ii+164+13 plates. Bulletin 153: A Manual of the Recent and Fossil Marine Pelecypod Mollusks of the Hawaiian Islands. By William Healy Dall, Paul Bartsch and Harald Alfred Rehder. Pp. iv+234+58 plates. Bulletin 154: Flowering Plants of Samoa, 2. By Erling Christophersen. Pp. 78+3 plates. Bulletin 155: Report of the Director for 1937. By Peter H. Buck (Te Rangi Hiroa). Pp. 30. Bulletin 156: Hawaiian Shore Fishes. By Victor Pietschmann. Pp. ii+56+18 plates. Bulletin 157: Ethnology of Mangareva. By Te Rangi Hiroa (Peter H. Buck). Pp. viii+520+9 plates. Bulletin 158: Zonitid Snails from Pacific Islands, Part 1. 1: Southern Genera of Microcystinæ. By H. Burrington Baker. Pp. ii+102+20 plates. (Honolulu: Bernice P. Bishop Museum.) [63

Proceedings of the First Session of the Indian Statistical Conference held in Calcutta, January 1938. Edited by Prof. P. C. Mahalanobis. Pp. v+312+2 plates. (Calcutta: Statistical Publishing Society; London: P. S. King and Son, Ltd.) [63

The Coconut Research Scheme, Ceylon. Bulletin No. 4: Geneticist's Annual Reports for 1936 and 1937. Pp. ii+58. (Lunuwila: Coconut Research Scheme.) [63

Journal of the Indian Institute of Science. Vol. 22A, Part 2: Supersonic Velocity in Gases and Vapours. Part 5: Heat Capacity of Vapours of Acetone, Benzene, Cyclohexane, *n*-Hexane, Methyl, Ethyl and *n*-Propyl Ethers. By S. K. Kulkarni Jatkar. Pp. 19–38. (Bangalore: Indian Institute of Science.) 1.8 rupees. [63

Indian Forest Records (New Series). Botany, Vol. 1, No. 3: A List of the Grasses of Assam. By Dr. N. L. Bor. Pp. v+47–102+5 plates. (Delhi: Manager of Publications.) 2.10 rupees; 4*s.* 3*d.* [63

### Catalogues, etc.

Watson's Microscope Record. No. 46, January 1939. Pp. 24. (London: W. Watson and Sons, Ltd.)

Zeiss Nachrichten. Folge 2, Heft 7, September 1938. Pp. 223–266. (Jena and London: Carl Zeiss.)

The Nivoc Supplement. No. 6, Series E, February. Pp. 12. (London: W. and J. George, Ltd.)

Catalogue of Books on Military History, including Regimental Records, The Great War, Uniforms, etc. (Catalogue No. 636.) Pp. 48. (London: Francis Edwards, Ltd.)

Actualités scientifiques et industrielles (1932–1939). Répertoire 1–809. Pp. 64. (Paris: Hermann et Cie.)

Lenses and Mirrors. (List No. 122.) Pp. 2. (Croydon: Gowllands, Ltd.)